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Solar Thermal Heating and Cooling
A Bibliography with Abstracts
Quarterly Update January-March 1979

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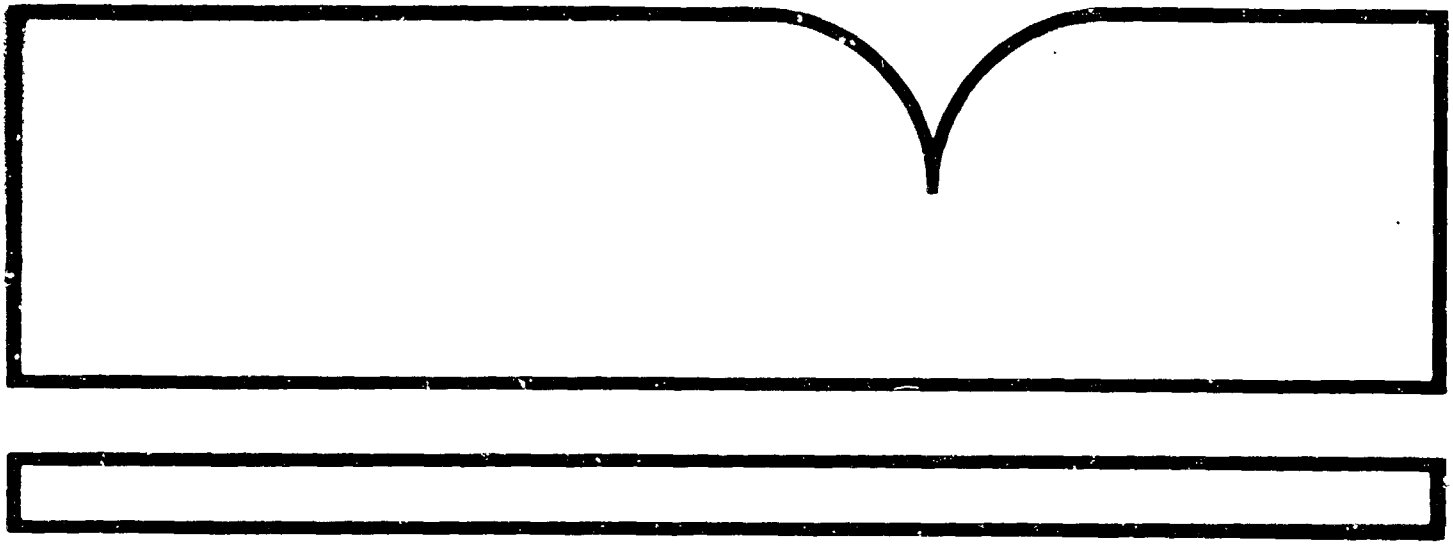

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Solar Thermal Heating and Cooling

Quarterly Update January-March 1979

TECHNOLOGY APPLICATION CENTER
THE UNIVERSITY OF NEW MEXICO
ALBUQUERQUE, NEW MEXICO 87131

SOLAR THERMAL HEATING AND COOLING

A BIBLIOGRAPHY WITH ABSTRACTS

QUARTERLY UPDATE

JANUARY-MARCH, 1979

PREPARED BY THE

ENERGY INFORMATION PROGRAM

of the

TECHNOLOGY APPLICATION CENTER

JUNE, 1979

THE UNIVERSITY OF NEW MEXICO
ALBUQUERQUE, NEW MEXICO

A DIVISION OF THE INSTITUTE FOR APPLIED RESEARCH SERVICES (IARS)

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Technology Application Center
University of New Mexico
Albuquerque, New Mexico 87131
(505) 277-3622

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INTRODUCTION

Many of the least expensive applications of solar energy today are in building design for lighting, heating, and cooling. For example, four articles under Architectural Considerations (33,000) discuss the use of windows and skylights for lighting and heat gain control. Several of these ideas are discussed in Architecture and Energy (30001), San Francisco Bay Area Solar Heating Guide and Directory (30028), and 30 Energy Efficient Houses You Can Build (30050).

This quarter of the Heating and Cooling section of the Solar Bibliography is missing many citations from journal articles published in the field. These citations will appear in the next quarterly publication.

Editing of the Bibliography has recently changed hands - there are three people now editing rather than one person. We will be able to offer a broader coverage of the literature than the work previously done. Readers and users of the Bibliography are encouraged to bring mistakes and omissions to our attention here at the Technology Application Center.

Mike Arenson
Co-Editor

GUIDE TO USE OF THIS PUBLICATION

A number of features have been incorporated to help the reader use this document. They consist of:

-- A TABLE OF CONTENTS; listing general categories of subject content and indexes. More specific coverage by subject keyword and author is available through the appropriate index.

-- CITATION NUMBERS assigned to each reference. These numbers, with the prefix omitted, are used to identify references found in the indexes. They are used as TAC identifier numbers when dealing with document order, so please use the entire (prefix included) citation number when corresponding with TAC. An open ended numbering system allows for easy incorporation of subsequent updates in this system, and numbers assigned to new citations will follow directly the last assigned numbers in the previous issue. Citation number of the last reference on each page appears in the upper right-hand corner to facilitate quick location of a specific article.

-- A REFERENCE FORMAT; containing the TAC citation number, title of reference, author, corporate affiliation, reference source, and abstract. The reference source tells, to the best of our knowledge, where the reference came from. If from a periodical, the reference source contains its title, volume, page number and date.

-- An INDEX OF AUTHORS; alphabetized by author's last name, followed by the reference citation number. For multiple authors, each one is indexed.

-- An INDEX OF KEYWORDS affords access to each citation through an assigned set of descriptive terms. All words pertaining to a reference are permuted alphabetically and the corresponding citation numbers appear as many times as there are keywords. These permuted keywords run down the center of an index page, while the remaining keywords are clustered adjacently. A "#" indicates the end of a set of keywords, while a "/" indicates where a set has been cut off within the line due to overflow.

-- A LIST OF ABBREVIATIONS used in describing frequently occurring titles or corporate sources.

CONTENTS

30,000 SYSTEM OVERVIEWS

ST79 30001 Architecture and Energy Book

Anchor Press, New York, NY
p. 332 1977 $12.95 ISBN-0-385-04250-7

Energy and architecture are interwoven, since buildings in which we live and work consume over one-third of all the energy used in the United States and 10 percent of all the energy used in manufacturing to build the buildings. The consumption of energy by the transportation sector affects the way communities, neighborhoods, and suburbs are planned. The author explores each facet of the interconnected systems that comprise buildings, exposing the weaknesses of previously unchallenged assumptions in the following chapters: The Extent of the Crisis; A History of Comfort With Low Technology; The Changing Form of Building; The Tall Building; The Materials of Building; The Systems Within Buildings; Lights and Lighting; Piped and Ducted Systems; Learning From the Schools; The Energy Needed to Live in the United States; Solar Heating Versus Electric Heating; Principles of Energy-Saving Architecture; Energy and Style; Energy Building and Ecology; The Aesthetics of Energy-Producing Facilities; The Needs of the United States Versus the Needs of the World; and The Chances and Choices.

ST79 30002 Building Technology Project Summaries, 1976, Special Final Pub.

Indiana State Board of Health, Advisory Comprehensive Health Planning Council, Indianapolis, IN
Avail:NTIS, NBS-SP-446-1 p. 85 July 1977

Energy Conservation; Energy Conservation in Communities; Solar Energy; Economics; Thermal Studies; Mechanical Systems; Plumbing; Sensory Environment; Materials; Structural; Disaster Mitigation; Architectural Research; Safety; Mobile Homes; Codes and Standards; Housing and Building Technology.

ST79 30003 Comparative Economics of Passive and Active Systems: Residential Space Heating Applications

Los Alamos Scientific Lab., Los Alamos, NM; Univ. of New Mexico, Albuquerque, NM
Proc. of Mtg. of Am. Sect. of ISES, Denver, CO, Aug. 28, 1978
Avail:NTIS, CONF-780808-7 p. 14

The economic performance of alternative designs are evaluated. One passive design is emphasized: the thermal mass storage wall. The economic performance of this design is examined and subsequently contrasted with one active design, the air collector/rock storage system. Architectural design criteria, solar performance characteristics, and the incremental solar cost of each design is briefly reviewed. Projections of conventional energy prices are discussed, along with the optimal sizing/feasibility criterion employed in the economic performance analysis. In addition, the effects of two incentive proposals, income tax credits and low interest loans, upon each design are examined. Results are reported on a state-by-state basis with major conclusions summarized for each design. It is generally the case that incentives greatly enhance the economics of both system designs, although the contrast is greater for the passive design. Also, against the less expensive conventional fuels (natural gas and heating oil) the passive design was shown to offer a more cost-effective alternative than the active system for most states.

ST79 30004 Continuation Study of the Potential for Solar Heating of Buildings in Canada

Univ. of Waterloo, Ontario, Canada
Avail:NTIS, NP-23162 p. 44 Aug. 1977

The printed output from Watsun, a computer program for simulating the performance of a solar heating system, was revised to provide more information to the user. A computer subroutine was added to Watsun to model a solar heating system with two liquid storage subsystems. Watsun was compared with existing simplified design methods.

ST79 30005 Control Systems for Heating, Ventilating, and Air Conditioning; Book

Van Nostrand Reinhold Co., New York, NY
p. 246 1977 $15.95 ISBN 0-442-23031-1

Hundreds of ideas for designing and controlling sophisticated heating, ventilating, and air conditioning (HVAC) systems are presented. Information is included on enthalpy control; energy conservation in HVAC systems; on solar heating, cooling and refrigeration systems; and on a self-draining water collector and heater. Computerized control systems and the economics of supervisory systems are discussed. Information is presented on computer system components, software, relevant terminology, and computerized security and fire reporting systems. Benefits of computer systems are explained, along with optimization techniques, data management, maintenance schedules, and energy consumption. A bibliography; glossaries of HVAC terminology, abbreviations, symbols; and a subject index are provided.

ST79 30006 Complete Solar House

Dodd, Mead, and Co., New York, NY
p. 219 1977 $6.27 ISBN 0-396-07493-6

The following subjects are included: an introduction to solar energy; a history of pioneers in the field; a description and explanation of solar collector, storage units, and distribution systems; a look at a typical solar hot water system, a swimming pool heating system, an air conditioning system, and a heating/cooling system. In addition, retrofitting is explored; the homeowner is told how to prepare his house for solar heat and the problem of installation costs is explored. How much sunshine can be expected every month of the year in various geographical locations is shown. A list of companies manufacturing solar energy components is included in an appendix.

ST79 30007 Design and Development of a Solar Powered Air Conditioning System, Technical Memorandum No. 46

Polytechnic of the South Bank, London, England
Avail:NTIS, NP-23067 p. 48 Nov. 1977 US Sales Only

The need for utilization of solar energy is discussed and the design, specification, and theoretical operation of a solar powered air conditioning system are described. It comprises focusing-type solar collectors linked to a lithium bromide-water vapor absorption unit serving a small building of 200 m^2 floor area with an average summer cooling load of 4.6 kW and a mean winter heating load of 3.4 kW situated in the London area. Integrated with the solar air conditioning plant is an 11,000-l hot storage tank which simulates conditions of constant solar energy supply. The system is shown to be 42 percent efficient when comparing cooling effect produced to incident solar radiation and to have a capital cost 40 percent greater than a conventionally powered air conditioning system. Provision is made also for solar heating of domestic hot water and running costs are minimal; the system produces 80 times its input of non-renewable energy.

ST79 30008 Economical Solar Heating and Nocturnal Cooling For Residences

Am. Soc. of Automotive Engnrs., St. Joseph, MI
Paper no. 77-4001 p. 20 1977

The paper reports on a solar attic system designed into an otherwise conventional three-bedroom, 1040-ft^2, wood frame, ranch-style house; the system can be readily adapted to nearly any house size or floor plan desired. The paper describes some of the methods used to minimize the costs of the solar system and presents performance data obtained by monitoring the prototype for one year of operation. An economic evaluation of residential solar heating is presented, based on the construction costs and performance of the prototype in Greenville, South Carolina. The system was field-tested for one year and the performance data is presented. An economic evaluation based on the actual cost and performance of the prototype shows the system to be feasible now for areas where energy costs are $0.035/kWh or above.

ST79 30009 Equipment for Heating a Liquid or Gaseous Heat Carrier Using Solar Radiation

German (FRG) Patent No. 2,555,229/A p. 16 June 16, 1977 In German

A flat collector is described. The absorber consists of flexible material. Two material strips are glued or welded to form a chamber for the heat transport medium, so that cylindrical hollowed out spaces are created in several places, which extend over the whole length of the absorber and open into a common pipe at the upper and lower ends. To reduce heat losses, the flexible absorber plate is covered by a strip of material transparent to light so that an air-filled intermediate space is formed which can be blown up. Several covering strips can be used. The water introduced via a valve leaves the absorber in free flow.

ST79 30010 Evaluation of a Residential Solar Air Heating and Nocturnal Cooling System

Colorado State Univ., Solar Energy Applications Lab., Ft. Collins, CO
Avail:NTIS, COO-2869-3 p. 161 Dec. 1977

A solar house heating system is described using approximately 700 ft^2 of air heating collectors, 363 ft^3 of pebble-bed storage, ducts of various sizes, a blower with a constant speed motor, and automatic controls to collect, store, and deliver solar heat to the building space. The design, operation, instrumentation, and data system; data reduction; system performance; economic analysis; and component performance are discussed.

ST79 30011 Examination of Aluminum Tubing Pitted in Stagnant Water

Oak Ridge Nat'l Lab., Oak Ridge, TN
Proc. of Mtg. of Int. Metallographic Soc. Houston, TX July 19, 1977
Avail:NTIS, CONF-770735-3 p. 33

A demonstration is being conducted to determine the feasibility of an annual cycle energy system (ACES) as an energy balance system for heating and cooling a house. The thermal storage consists of water in a 19 x 17.5 x 7.5 ft (18,655 gal) tank. During the winter season, heat for the house would be extracted from the water thereby converting the water to ice. During the summer the ice would provide the space cooling. A part of the initial demonstration involved the testing of series 1100 ½-in-diameter aluminum alloy, finned tubing as the basic thermal transfer via a 15 percent methanol brine solution. During this demonstration, corrosion pits developed and penetrated the aluminum alloy tubing as pinholes in several locations. An investigation of some probable causes of the pinholes is reported. This examination includes optical and scanning electron microscopy displays of the holes, as well as energy dispersive x-ray analyses of the products contiguous to the holes.

ST79 30012 Fuel Savers: A Kit of Solar Ideas for Existing Homes

Total Environment Action, Inc., Harrisville, NH
p. 63 1978 $2.75 ISBN 0-931426-00-6

This book presents a variety of ways to use solar energy; it does not discuss pre-engineered and manufactured products. Subjects covered are energy conservation; solar energy; kit of ideas on inside, integral, and attached free-standing and new living structures; and solar hot water heaters. Choosing a system with examples of ideas applied to six houses concludes the contents. A complete bibliography is given.

ST79 30013 Heating of a Poultry Broiler House Using Solar Energy

Am. Soc. of Automotive Engnrs., St. Joseph, MI
Paper no. 77-3005 p. 14 1977

A pre-engineered metal building has been modified to be used as a solar-heated poultry broiler house. The solar collector is an air heater system incorporated into the south wall of the building. The system was operated in a single-pass mode with no air recirculation. The collectors performed well under the test conditions. The rock bed heat storage system proved to extend the heat output into the room through most of the night. Heat storage was always exhausted before sunrise even after a day with high insolation. This system was found suitable for producing sufficient heat to maintain the poultry house at the desired temperature of 29.5 C during the first week of the chick's life under ideal insolation conditions. Under cloudy conditions supplemental heat was required. The most desirable feature of this design is the low cost of the solar collector.

ST79 30014 How to Use Solar Energy in Your Home and Business; Book

Ward Ritchie Press, Pasadena, CA
p. 318 1977 $7.95 ISBN 0378-06380-4

The book accumulates explanations about solar energy and solar hardware in 12 chapters, namely: How to Cut Your Utility Bills; Solar Water Heating--New Techniques For Saving Money; Installing a Commercial Solar Water Heater; Solar Space Systems, Liquid Type; Advantages of Air-Type Solar Collector Systems; Solar Heat for Summer Cooling; Passive Solar Techniques--Versatile and Low Cost; Solar Heating for Swimming Pools and Spas; Solar Heating Systems Need Automatic Controls; Solar Energy for Your Business--A Necessity Soon; Solar Cells, Space Stations, and Electric Cars; and Windmills as Power Plants.

ST79 30015 Hybrid Passive/Active Solar House: First Year Performance of the Hunn Residence

Los Alamos Scientific Labs., Los Alamos, NM
2nd Nat'l Passive Solar Conf. Philadelphia, PA March 15, 1978
Avail:NTIS, CONF-780337-4

The solar heating system consists of a Trombe wall constructed of 1-ft-thick slump block and a rock bed storage system that can be charged by blowing air through the Trombe wall air space and into the rock bed. Operating results of the system, which is being monitored by the Los Alamos Scientific Laboratory (LASL), are reported for just over the first year of operation (1977 and part of 1978). In addition, occupant observations and conclusions are presented. Energy consumption records for 1977 indicate that approximately 60 percent of the space heating load was provided by solar energy.

ST79 30016 Hydroponic Plant Production in Greenhouse Bulk Curing Solar Barn

Am. Soc. of Automotive Engnrs., St. Joseph, MI
Paper no. 77-1012 p. 21 1977

Hydroponic plant culture was studied for all-the-year-round utilization of solar energy in a greenhouse solar barn system. Water level fluctuation method was developed for effective plant production and solar energy storage. Both computer simulation and experimental results showed the feasibility and advantages of this plant production system. A method for root system aeration in water culture was investigated and found to be feasible. Appropriate climatic and cultural factors required for producing crops hydroponically could be afforded by the air flow and environmental con-rols available in the bulk curing solar barn considered. An automatic control system to fluctuate the nutrient solution within the vicinity of the plant root system was found to be satisfactory. Solar energy could be effectively utilized to heat the nutrient solution with a system of solar panels in conjunction with the control system.

ST79 30017 Liquid Circuit System With Stores, To Generate Heat, Particularly From Solar Radiation

German (FRG) Patent no. 2,604,361/A p. 5 Aug. 18, 1977 In German

The invention concerns a liquid circuit system for generating heat, particularly in connection with solar collectors. The heat energy gained in the collector is transported to a store which is situated at a higher level than the collector so that the gravity can be used and no circulating pump is required. A hose colored black is used as collector. Transparent hoses can also be used. In this case the liquid is colored black and a heat exchanger is interposed between collector and store.

ST79 30018 Method For Temperature Controlled Water Heating by Means of Solar Energy

Brown, Boveri, und Cie A.G., Germany, F.R.
German (FRG) Patent no. 2,554,975/A p. 8 June 16, 1977 In German

A method for the temperature controlled heating of water by means of solar energy is described. The temperature difference is measured within a temperature transmitter and used for regulating a circulation pump. The temperature transmitter is placed in the return pipe of a solar collector and forms one unit with the collector. The transmitter is designed in such a way that its output signal follows the intensity of the solar radiation falling in almost inertia-free.

ST79 30019 Overview on Absorption Cooling Technology in Solar Applications

Brookhaven Nat'l Lab., Upton, NY
3rd Workshop on Use of Solar Energy For Cooling Bldgs. San Francisco, CA
Avail:NTIS, CONF-780249-2 p. 6 Feb. 15, 1978

The following topics are reviewed briefly: chiller performance, commercial availability, system performance, internal energy storage, water cooling limitation, COP limitation, absorption heat pump, and DOE activities.

ST79 30020 Passive Testing at Los Alamos

Los Alamos Scientific Lab., Los Alamos, NM
2nd Nat'l Passive Solar Conf. Proc. Philadelphia, PA March 15, 1978
Avail:NTIS, CONF-780337-3 p. 6

The testing program directed toward the evaluation of passive solar heating concepts is described. The Los Alamos Scientific Laboratory is monitoring 15 passive solar heated buildings, all in the private sector, and all but one in northern New Mexico. The purpose is to evaluate a wide variety of passive solar heating concepts under similar conditions. The buildings are described but few results are yet available. Results from passive solar heated test rooms at Los Alamos are presented. Of a total of 14 test rooms, data are presented for nine for both a sunny day and a cloudy day. These include two water walls; five Trombe walls, one vented and the others unvented, one plain; two with night insulation, Beadwall and night shade; and one with multiple glazings; two direct gain rooms, one plain and one with a three-layer roll-down shade; and an air convective loop. The characteristics of the rooms are described and tentative conclusions are drawn from some of the data.

ST79 30021 Performance Comparison Between Air and Liquid Residential Solar Heating Systems

Colorado State Univ., Solar Energy Applications Lab., Ft. Collins, CO
Avail:NTIS, COO-2868-4 p. 20 Jan. 1978

Comparisons of system performance for the flat-plate liquid-heating system in CSU Solar House I, the evacuated-tube collector system in Solar House I, and the flat-plate air-heating system in CSU Solar House II are described for selected months of the 1976 and 1977 heating seasons. Only space and domestic water heating data are compared. The flat-plate air and liquid-heating collectors operating with complete heating systems have nearly equal efficiencies when based upon solar flux while the collector fluids are flowing, but approximately 40 percent more energy is collected during a heating season with the air-heating system because the air system operates over a longer period of the day. On the basis of short-term data, the evacuated tube collector array on Solar House I is about 27 percent more efficient than the flat-plate air-heating array on Solar House II based on gross roof area occupied by the collectors and manifolds.

ST79 30022 Performance of a Plastic Solar Air Heater

Am. Soc. of Automotive Engnrs., St. Joseph, MI
Paper no. 77-4014 p. 14 1977

The paper reports on a study to develop a low-cost solar air heater capable of moderate air temperature rises that can be used for crop drying and other applications requiring heated air. The collector under investigation is basically a plastic flat-plate collector with a black plastic screen suspended between the clear plastic glazing material and the black plastic absorber. Behind the black plastic there is a layer of insulation boards to reduce heat losses. The plastic screen increases the heat transfer area and the convective heat transfer coefficient between the absorber and the air. Since the heat transfer area is increased, the temperature of the absorber is reduced and heat losses to the surroundings are consequently less. Also, by operating at lower temperature, the useful life of the plastic absorber is extended.

ST79 30023 Plant Engineers' Solar Energy Handbook, Southern California Region

Univ. of California, Lawrence Livermore Lab., Livermore, CA
Solar Workshop for Plant Engineer, Proc. Los Angeles, CA March 1978
Avail:NTIS, LLL/M-087 p. 335

Discussed in order after the introduction are solar components and systems (collectors, storage, service hot water systems, space heating with liquid and air systems, space cooling, heat pumps, and controls); computer programs for system optimization; local solar and weather data; a description of buildings and plants in southern California applying solar technology; current federal and California solar legislation; standards, codes, and performance testing information; a listing of manufacturers, distributors, and professional services available in southern California region; and information access. Finally, solar design checklists for those engineers who wish to design their own systems The program for the Solar Workshop for the Plant Engineer, March 30, 1978, Los Angeles, California is included.

ST79 30024 Plant For Using Solar Heat

Linde A.G., Wiesbaden, Germany, F.R.
German (FRG) Patent no. 2,550,413/A p. 14 May 18, 1977

The invention concerns plant for using solar heat where the heat collected in a solar collector is given up via a working medium pumped round the circuit and is converted into useful energy, preferably electrical energy, within this circuit. A low-pressure cooling medium is used as heat transport medium which takes away the heat energy obtained in the collector. This cooling medium evaporates in the solar collector ans is then reduced in pressure in a screw expansion machine. After condensing in a condenser, the cooling medium is returned to the collector. The kinetic energy gained in the expansion machine is converted to electrical energy in a generator. In order to be able to operate the plant during periods of little sunshine, a directly heated thermal store, e.g., a rock store, can be included in the circuit of the working medium which takes up excess energy in periods with plenty of sun.

ST79 30025 Process for Operating a Collector System for Solar Radiation and Equipment for Carrying Out the Process

Scientific-Atlanta, Inc., Atlanta, GA
German (FRG) Patent no. 2,707,803/A p. 45 Sept. 1, 1977

The invention refers in general to solar collector systems in which the heat transfer liquid flows down a flow channel under gravity and is heated by solar radiation. The collector consists of a large number of collector pans of standard construction which are connected in series The heat transfer liquid flows in the flow channel as a thin film. In this way, the heat transfer liquid spreads over the whole floor surface of the heat transmission channel so that a maximum of solar energy can be absorbed. The heat transfer liquid also has a low partial vapor pressure so that losses by evaporation are avoided.

ST79 30026 Representative Industrial Solar Energy Installation, Northridge Hospital, Northridge, California

Grossman (R.D.) and Associates, Canoga Park, CA
Avail:NTIS, UCRL-13789 p. 78 Dec. 29, 1977

An engineering package for the design of a solar water heating system for the Northridge Hospital, a 300+-bed hospital in southern California, is presented. Flat-plate collectors are utilized. Specifications and drawings of the system are given. Also, calculation sheets are included for the support system structural analysis, heat exchanger performance check, pipe size and pressure load calculations, pump selection analysis, solar collector thermal performance, and collector attach system design requirements.

ST79 30027 Role of the Vapor Compression Cycle in Solar Energy Utilization

Brookhaven National Lab., Upton, NY
Mtg. Proc. of Am. Sect. of ISES Denver, CO Aug. 28, 1978
Avail:NTIS, CONF-780808-14 p. 5

The vapor compression cycle lends itself to solar energy utilization in two important ways. Its ability to utilize a relatively low-temperature heat supply to produce space heating via heat pumps allows the use of solar input to the evaporator to provide potential coefficients of performance which are two to three times higher than present electric driven heat pumps, and the use of relatively inexpensive solar collectors is possible since the collection temperatures can be low grade. Secondly the compression process of the vapor cycle can be powered by a solar-driven heat engine, typically using a Rankine cycle for solar cooling purposes. Discriminating coupling of solar with vapor compression allows the well-developed technology and manufacturing capability of the vapor compression industry to be brought into play in the solar field, widening its base and promoting its diversification. The cycle thermodynamics, potential practical hardware, and R and D projects in both of these areas are reviewed. Particular attention is given to the solar-assisted heat pump and its characteristics and the heat pump simulator activities at Brookhaven National Laboratory.

ST79 30028 San Francisco Bay Area Solar Heating Guide and Directory

Solar Energy Information Services, San Mateo, CA
p. 60 1977 $5.95

The following topics are discussed: the collection of solar energy, solar heating applications, economics of solar heating, and solar heating information resources. Included in the appendices are a product and service directory and an address and telephone directory.

ST79 30029 Solar Collector Related Research and Development in the United States For Heating and Cooling of Buildings

Los Alamos Scientific Lab., Los Alamos, NM
Symp. on Solar Energy Cairo, Egypt June 16, 1978
Avail:NTIS, CONF-780667-2 p. 39

Some of the research funded by the Research and Development branch of the Heating and Cooling Division of Solar Energy of the United States Energy Research and Development Administration is described. Specifically, collector and collector materials research is reported on during FY-1977. The R and D branch has funded research in open and closed-cycle liquid heating flat-plate collectors, air heating flat-plate collectors, heat pipe collectors, concentrating collectors, collector heat transfer studies, honeycomb glazings, evacuated tube collectors, ponds both salt gradient and viscosity stabilized, materials exposure testing, collector testing standards, absorber surface coatings, and corrosion studies. A short description of the nature of the research is provided as well as a presentation of the significant results.

ST79 30030 Solar Collectors For Cooling Applications

Los Alamos Scientific Lab., Los Alamos, NM
3rd Workshop on Use of Solar Energy for Cooling Bldgs. San Francisco, CA
Avail:NTIS, CONF-780249-4 p. 10 Feb. 15, 1978

Collector research projects funded by the R and D branch for Heating and Cooling, Department of Energy, which have direct applicability as cooling machine prime movers, are described. Performance curves are given where they are available along with the development status and the market availability.

ST79 30031 Solar Collectors, Part II: Recent Developments and Future Performance Data and Economic Analysis

Los Alamos Scientific Lab., Los Alamos, NM
Symp. on Solar Energy Cairo, Egypt June 16, 1978
Avail:NTIS, CONF-780667-1 p. 26

The concepts, materials, and collector types indicative of recent developments in solar collector research for increasing thermal performance are listed by category. The categories are: selective surfaces, honeycombs, all-glass evacuated tube collectors, nontracking concentrating collectors, tracking concentrating collectors, and heat pipe collectors.

ST79 30032 Solar Energy Book

Ottaviano Tech. Services, Inc., Melville, NY
p. 397 1977

This book is divided into the following sections: (1)national energy policy, (2)the justification of using solar energy, (3)data concerning solar energy, (4)products available, (5)applications of these products, (6)economics, and (7)future applications.

ST79 30033 Solar Energy for Buildings, Houses, and Pools

Marshal F. Merriam, Berkeley, CA
p. 319 1977 NP-22760

The following chapters are included: Solar Collectors, Domestic Hot Water, Insolation, Solar Space Heating, Solar Cooling, Passive Space Heating, Industrial and Commercial Applications, Swimming Pool Heating, and appendices.

ST79 30034 Solar Energy for Supplemental Heating of Livestock Buildings

Am. Soc. of Automotive Engnrs., St. Joseph, MI
Paper no. 77-3004 p. 32 1977

A study to design and compare the efficiencies and total energy supplied by three types of low-cost, low-temperature rise bare-plate solar collectors is described. The performance of solar collectors that can be readily adapted to many livestock confinement buildings currently used were evaluated, and the economic feasibility and potential energy

savings of low-cost, low-temperature rise solar collectors for providing supplemental heat to livestock confinement buildings are discussed. Among the results reported is that significantly better performance was noted with a vertical sidewall collector as compared to either a roof collector or a combined roof-sidewall collector. Economic feasibility was indicated for the sidewall solar collector.

ST79 30035 Solar Energy System Description Document, Iris Images System, Site ID 010, PON 2146

Int. Business Machines Corp., Huntsville, AL
Avail:NTIS, SOLAR/2005-77/13 p. 19 Oct. 28, 1977

The Iris Images Solar Energy Installation provides process hot water for a photographic film processing laboratory located in Mill Valley, California. Auxiliary heating is supplied by a 270,000-BTU/hr gas heater. The system consists of two banks of collectors constructed on-site, which provide 640 ft^2 of absorber surface, 360 gallons of solar heated hot water storage in three 120-gallon tanks, a 100-gallon gas heated auxiliary back-up, a pump, and interconnecting piping. Four photo-processors provide the primary load for the system. Each processor input hot water temperature is adjusted by a mixer valve. The valves are set to the temperature requirements of the particular film type being processed, thus vary from time to time. Solar energy derived hot water is also used in six sinks and two bathrooms in the building.

ST79 30036 Solar Energy System Description Document, Loudoun County Site, Site ID 033, PON 2157

Int. Business Machines Corp., Huntsville, AL
Avail:NTIS, SOLAR/2016-77/13 p. 17 Oct. 28, 1977

The solar heating system for the Loudon County site provides solar preheating of the domestic hot water supply for the Charles S. Monroe Vocational-Technical School at Leesburg, Loudon County, Virginia. In this area the predominant method of providing hot water has been through the use of fuel-oil water heaters. In the current system solar energy is collected by an array of flat-plate modular collector surfaces and transmitted via the collector working fluid to a heat exchanger in a large solar storage preheat tank. The preheated water from the solar storage tank is then supplied on demand to a smaller storage water heater. Additional heat is supplied, if required, by an auxiliary electrical heating element in the storage water heater. A recirculating system is active during normal use hours to keep hot service water available immediately at all hot water taps. Cold make-up water enters the solar tank as hot water demand is initiated at any tap. Cold water is also allowed to enter the hot water lines through temperature controlled mixing valves to prevent service water from exceeding the desired temperature. The building is a single-story school building used as a vocational-technical training center for older teenage and adult students. The anticipated school population is 350 students. The hot water supply is used in washroom and kitchen facilities, primarily during daylight and early evening hours.

ST79 30037 Solar Energy System Description Document, Moulder Corporation, Site ID 050, HUD Grant H2754

Int. Business Machines Corp., Huntsville, AL
Avail:NTIS, SOLAR/1001-77/13 p. 16 Nov. 30, 1977

The Moulder solar energy system provides space heating and hot water for a private single-family dwelling located in West Greenwood, Indiana. Air is forced through roof-mounted collector panels where it is heated and then the air transfers this heat for storage to a 855-ft^3 rock bin. Space heating is provided directly from the collector panels or by circulation through the rock storage bin. Additional heating is supplied by an auxiliary electric heater if the collected solar energy is not sufficient to meet the heating load. Hot water is provided by circulating the heated air through an air-to-water heat exchanger which preheats the water prior to entering a conventional electric water heater. Additional heat is supplied within the hot water tank as required to maintain the desired water temperature.

ST79 30038 Solar Energy System Performance Evaluation, Iris Images, Interim Report

Int. Business Machines Corp., Huntsville, AL
Avail:NTIS, SOLAR/2005-77/14 p. 47 Nov. 1977

A detailed performance evaluation, based on instrumented data collected between June 1977 and September 1977, of the Iris Images Solar Energy System has been completed. During this analysis it was found that excessive losses are occurring from uninsulated pipes and manifolds between the collector and the pre-heat tanks. In addition, it was discovered that the collector controller is unstable in periods of low insolation because its set points are mismatched. A TRNSYS simulation model was developed and used to predict fossil energy savings of 140 million BTU per year. Recommendations were made to insulate the pipes and manifolds to reduce the energy losses and increase system performance. It was also recommended that the collector controller set points be changed to prevent premature failure of the pump. In addition to the recommendations for system changes, it was also recommended that the performance evaluation be continued in order to evaluate the system under a wider range of operating conditions and to validate the simulation model.

ST79 30039 Solar Heating and Cooling Demonstration Program Contractor's Review, Summary and Analysis of Workshop and Panel Sessions

Univ. of Alabama, Kenneth E. Johnson Environ. and Energy Center, Huntsville, AL
Solar Heating and Cooling Demonstration Program Contractors' Review New Orleans, LA
Avail:NTIS, CONF-771229-(summ.) p. 43 Dec. 5, 1977

The Solar Heating and Cooling Demonstration Program Contractors' Review was held in New Orleans, Louisiana, during December 5 to 7, 1977. This review was sponsored by the United States Department of Energy, Office of Solar Applications and supported by the contractual efforts of PRC Energy Analysis Company and the University of Alabama in Huntsville. The proceedings containing all available papers and presentations were made available at the time of the review. This workshop summary contains the results and summaries of the five workshops and panel session held on Wednesday, December 7, the final day of the program. The workshops reflected much of the interests and concerns of the various attendees and generally represent a summary of the overall program. The workshops included: (1)design concepts, philosophy, and techniques; (2)installation, construction, and hardware procurement; (3)operational and performance factors; (4)economic, environmental, societal, and institutional issues; and (5)overview of national demonstration programs.

ST79 30040 Solar Heating and Cooling, Recent Advances; Book

Noyes Data Corp., Park Ridge, NJ
p. 492 1977 ISBN-0-8155-0674-0

The United States patent literature on solar heating and cooling since 1970 is covered in the following chapters: Flat-Plate Collectors, Focusing Collectors, Upright Collectors, Other Collectors, Coatings, Storage Devices, Heating and Cooling Systems, Domestic Hot Water Systems, and Swimming Pool Applications. The material is indexed by subject, company, inventor, and patent number.

ST79 30041 Solar Home Heating in Canada: Problems and Prospects

Dept. of Fisheries and Environ., Ottawa, Canada
Report no. 16, p. 237 1977 ISBN-0-662-00974-6

This study of the barriers and incentives to the adoption of solar home heating in Canada is also a study of the diffusion of innovation. The process of change and the roles of the participants are discussed at length. Recommendations, a solar energy questionnaire, and a resume in French are included.

ST79 30042 Solar House of the Eindhoven University of Technology

Technische Hogeschool Eindhoven, Netherlands
Avail:NTIS, NP-23100 (US Sales Only) p. 32 1977

The components of the solar heating system are described, as well as the adaptations in the house design to take care of the solar system. The research program and measuring system, and the performance of the solar heating system are included.

ST79 30043 Solar-Thermal Heating Systems, Technical Aspects and Economic Limits

Oldenbourg, Meunchen, Germany, F.R.
p. 216 1977 In German ISBN-3-486-20681-8

After a general introduction of the principle of solar energy utilization and an explanation of boundary conditions, the author deals with the technical possibilities of solar energy conversion for space heating. A cost analysis shows the advantages and possible profitability of this sort of heating. For the time being, however, we must reckon with long amortisation times of 10 to 15 years. With regard to a relative cost comparison with other energy sources and to the potential of this energy conversion which is not being used yet, this system is sure to gain an important part of the energy supply in the future.

ST79 30044 Space Heating System Efficiency Improvement Program (SHEIP)

Am. Gas Assoc., Washington, D.C. 1978

The gas industry's Space Heating System Efficiency Improvement Program (SHEIP) was initiated in the summer of 1976 to accelerate the industry's continuing efforts to help its customers use gas more efficiently. The purpose of SHEIP is to determine the energy savings and encourage implementation of the useful and safe options for improving energy efficiency in residential natural gas central heating systems.

ST79 30045 Studies of Evaporative and Conventional Cooling of an Energy Conserving California House

Univ. of California, Lawrence Berkeley Lab., Berkeley, CA
2nd Nat'l Passive Solar Conf. Philadelphia, PA March 15, 1978
Avail:NTIS, LBL-6888 p. 7

For cooling a Sacramento, California home: (1)higher thermostat settings, (2)insulation, (3)"solar control" window shades, and (4)the use of an evaporative cooler in the place of a vapor compression cycle air conditioner are studied. A computer program twozone is used to evaluate the effect on energy consumption and peak power. It is calculated that the peak cooling load can be reduced by a factor of five or more and the total energy by a factor of 20 or more.

ST79 30046 Study Guide for Fundamentals of Solar Heating, A Correspondence Course for the Air Conditioning Industry

Sheet Metal and Air Conditioning Contractors Nat'l Assoc., Vienna, VA
Avail:NTIS, HCP/M4038-02 p. 118 Jan. 1978

The study guide to accompany the corresponding course (HCP/M4038-01) groups the 11 lessons into four study units. There are review tests and unit examinations, structured for assistance in reviewing the material and in integrating new information with that learned previously.

ST79 30047 Solar Heating and Cooling of Buildings (SHACOB) Commercialization Report, Part A, Options and Strategies, Volume 1, Executive Summary, July 1977

Midwest Res. Inst., Kansas City, MO
Avail:NTIS, HCP/M70065-01 May 1978

Potential barriers to the commercialization of solar heating and cooling of buildings in the residential and commercial sectors are analyzed, and government incentives that could accelerate the commercialization process are investigated. Solar hot water and space heating are emphasized.

ST79 30048 Supplemental Solar Heater for Egg Production

Am. Soc. of Automotive Engnrs., St. Joseph, I
Paper no. 77-4015 p. 1-9 1977

A low-cost, flat-plate single-air-pass solar collector was constructed to provide supplemental heating for a 5000-bird poultry laying house in Michigan. This heat is to be used to maintain 70° F environmental temperature, increase feed efficiency of the laying hens, maximize in-house excreta drying and minimize undesirable odors. The 1200-ft^2

surface area is south facing and tilted at an angle 30° from the vertical for maximum winter solar energy absorption. The absorber plate is square ridged, black painted aluminum roofing material with a single glazing of 1/8 tempered glass supported 3/4 in. above the plate. The air duct behind the absorber plate is 2.25 in x 18 in wide. The whole structure is 10 in. high and 120 in. long.

ST79 30049 System Definition Study: Phase 1 of Individual Load Center, Solar Heating and Cooling Residential Project, Final Report

Little (Arthur D.), Inc., Cambridge, MA
Avail:NTIS, EPRI-ER-594 p. 275 Dec. 1977

A study was carried out to determine preferred systems for residential solar and load management heating, cooling, and domestic hot water systems in the northeast and southeast regions of the United States. The program (1)developed a methodology for relating the performance of solar and load management heating and cooling systems to utility power generation, costs of supply, and weather characteristics; (2)identified preferred systems in the service areas of two utilities, Long Island Lighting Company (LILCO) and Public Service Company of New Mexico (PNM); (3)developed preliminary designs for five experimental systems in both the LILCO and PNM service areas with the intent of maximizing the acquisition of experimental information on systems compatible with utility operations; and (4)developed instrumentation and test and evaluation plans for the experiments. The methodology provides a means of determining systems which, on a life-cycle cost basis, minimize the total cost of meeting the energy needs for a specific application, including investments in generating capacity at the power plant, fuel costs and investments at the point of use for energy conservation, and HVAC equipment. The methodology was tested for 14 additional utilities throughout the United States.

ST79 30050 30 Energy Efficient Houses You Can Build; Book

Rodale Press, Emmaus, PA
p. 336 1977 ISBN-0-878[illegible]-191-4

This book is about how to build tomorrow's house--today; how to build a house that is energy-efficient, solar heated, uses every inch of space well, is designed for the people who plan to live there, is elegantly simple, and yet doesn't cost a small fortune. It is a picture book with photographs of innovative houses and their special details, both inside and out: partially buried hillside houses, small studio livingspaces, and larger one-family dwellings; it's a workbook with floor plans, drawings, and specifications for each house. Emphasis is on how to: design efficiently and not waste space; take advantage of solar energy by attaching a solar greenhouse or designing a solar-tempered dwelling; take advantage of shortcuts for foundations, floors, and roofs; use recycled materials; build your own windows, skylights, and doors; use the earth as insulation by building into a south-facing hillside; save money on kitchen and bathroom installations and innovative designs; use post and beam construction to build a sturdy, inexpensive frame; heat more efficiently with wood; and avoid hassles with banks and building code officials.

ST79 30051 Comparison of the Assumptions, Methodologies, and Conclusions of Three Residential Space Conditioning System Studies

Booz, Allen, and Hamilton, Inc., Bethesda, MD
Avail:NTIS, TID-28506 May 1978

The results, assumptions, and methodologies of three studies are compared which analyzed the relative costs and energy efficiencies of producing residential space conditioning energy via electric or gas systems, using coal as the primary fuel source. Each of the studies had differing conclusions regarding the relative advantages of gas and electric systems. The reasons for these differences are explained. Additionally, the important factors that should be included in any study of alternative space conditioning systems in order to ensure that valid and accurate conclusions can be made concerning the relative advantages of one system versus another are outlined.

ST79 30052 Thermal Performance of an Open Fluid Film Solar Collector

Beard, J.T.; Iachetta, F.A.; Messer, R.F.; Huckstep, F.L.; May, W.B.Jr.
Univ. of Virginia, Charlottesville, VA
Flat-Plate Solar Collector Conf. Proc. Orlando, FL Feb. 28, 1977
CONF-770253 p. 67-73

An outdoor solar test facility has been designed and constructed for determining steady-state thermal performance of an open fluid-film solar collector. Full-size collectors are tested under various ambient and fluid flow conditions. The open fluid-film solar collector is similar in principle to an open water-trickle solar collector. However, the fluid flows as a near-uniform film over a flat collector plate and typically the fluid is a silicone oil which appears to have negligible evaporation. Thermal performance results are presented in standard graphical and tabular forms for high and low wind conditions.

ST79 30053 Page-Jackson Elementary School Solar Heating and Cooling System

Costello, F.A.; Jain, A.K.; Kumar, S.; Liers, H.S.; McEver, W.
Intertech./Solar Corp., Warrentown, VA
Proc. of 12th Intersoc. Energy Conversion Engng. Conf., V 2 Washington, D.C.
Am. Nuclear Soc., Inc., La Grange Park, IL Aug. 28, 1977 p. 1255-1262

Solar heating and cooling is to be provided on the Page-Jackson Elementary School near Charleston, West Virginia. The system was designed by Intertechnology/Solar Corporation in 1975 and is currently being installed. The system and how it was selected from various alternatives are described. A direct solar heating system is used and an absorption refrigeration system is used for solar cooling. Two large water tanks are used for sensible heat storage. The trade-off analysis and system performance are discussed.

ST79 30054 Solar Energy: Its Conversion and Utilization

Farber, E.A.
Univ. of Florida, Gainesville, FL
Proc. of 14th Space Congress on Space Tech. for Better Living Cocoa Beach, FL
Canaveral Council of Tech. Societies, Canaveral, FL April 27, 1977 p. 4.1-4.4

The needs, status, and potential of solar energy are presented and the various applications are put into proper perspective. The fact is emphasized that all energy sources are needed to solve the energy problems and the ones should be used which can do the job best. It is also pointed out that one must learn to live off energy income instead of savings and with solar energy the only large inexhaustible income, the choice is limited.

ST79 30055 Conversion of an Existing Poultry House to Collect Solar Energy

Forbes, R.E.
Mississippi State Univ., Mississippi State, MS
Proc. of 1977 Flat-Plate Solar Collector Conf. Orlando, FL Feb. 28, 1977
CONF-770253 p. 111-118

A low-cost solar air heater was constructed on an existing poultry building at Mississippi State, Mississippi. Air flow channels below the galvanized roof were formed by covering the underside of two-inch by four-inch purlins with one-inch polyurethane and 1/4-inch plywood. The galvanized roof was painted with heat-resistant flat black paint and glazing was supported 1/2-inch above the corrugation peaks. Total collector area was 720 ft^2; half covered with 2' x 3' double-strength glass and half covered with 0.060-inch 4' x 8' Lexan. The collector tilt angle was dictated at 15° by the slope of the roof on the existing structure. The collecting area faced due south. The roof was subdivided into two separate segments in order to compare performance of the glass and Lexan-covered sides. Provisions were made to measure the air flow rate in each segment of the roof. Efficiency of the collector system was measured at four air flow rates through the system. The collection efficiency increased linearly with air flow rate with an average efficiency around 30 percent. Curves are presented which indicate performance of the system for a typical day; where ambient temperature, collector exit temperature, and heat collection rate are plotted versus time of day for a given air flow rate. Ambient air was pulled into the collectors during all tests.

ST79 30056 Solar Energy Study for the Naval Regional Medical Center, Orlando, Florida

Hadden, R.M.; Rainer, G.
Flack and Kurtz, Consulting Engnrs., New York, NY
Flat-Plate Solar Collector Conf. Proc. Orlando, FL Feb. 28, 1977
CONF-770253 p. 587-602

Since the utilization of solar energy is only one of many energy conservation measures, it was necessary to analyze all of the energy requirement of the medical center as a whole. Energy requirements vary throughout the year based on weather conditions. In order to obtain a clear understanding of these annual patterns, a dynamic load analysis was performed. The building was divided into 11 thermal blocks; that is, areas having similar thermal characteristics and use patterns. Using the program developed by Ross Meriwether Associates in conjunction with weather tapes as compiled for Orlando, Florida by the United States Weather Service, energy requirements for every hour of the year for each of the thermal blocks were obtained. Monthly and annual summaries for heating and cooling requirements for all thermal blocks were the result. Medical facilities have large service hot water requirements for laundries, clinics, food service, and general clean-up. These requirements were also input into the computer program as separate thermal blocks. Results are shown. The medical center has certain requirements for steam in kitchen facilities and for sterilizers; these needs were derived. The basic fan and pump electric requirements were determined so that changes for the solar system's use could be evaluated.

ST79 30057 Flat-Plate Collector Performance In a Solar-Assisted Heat Pump System

Hewitt, E.; Raman, K.
Solar Associates, Hartford, CT
Proc. of 1977 Flat-Plate Solar Collector Conf. Orlando, FL
CONF-770253 p. 253-263 Feb. 28, 1977

In the work discussed here, the characteristics of a flat-plate collector determine the overall performance of a solar-assisted heat pump system with long-term storage and year-round operation in a northern climate are examined. The economics of the system are discussed for different performance characteristics of the flat-plate collector. It is shown that for a range of values of the load it is possible to design a cost-effective high-performance system with relatively small collector area. The sizing of the collector, as determined by the two-stage, year-round operation of the system, is discussed in detail. It is pointed out that the use of high-performance flat-plate collectors (which implies a larger collector cost) can result in a lower total cost for the overall system for a wide range of system parameters.

ST79 30058 University of Florida Solar House

Ingley, H.A.
Univ. of Florida, Gainesville, FL
Proc. of 14th Space Congress on Space Tech. for Better Living Cocoa Beach, FL
Canaveral Council of Tech. Societies, Canaveral, FL April 27, 1977 p. 4.5-4.11

Over the past 20 years, the University of Florida Solar Laboratory has contributed substantially to the knowledge now used in solar energy applications. One of the primary research objectives in recent years has been the utilization of solar energy at the residential level. Research in the areas of solar space heating and cooling, solar heated domestic water, solar cooking, and solar distillation of waste water are examples of the effort being made to meet this objective. Information is presented on each of these efforts. Details on system component design and evaluation are also included in this discussion.

ST79 30059 Baseline Performance of Solar Collectors for NASA Langley Solar Building Test Facility

Knoll, R.H.; Johnson, S.M.
NASA, Cleveland, OH
Flat-Plate Solar Collector Conf. Proc. Orlando, FL
CONF-770253 p. 485-500 Feb. 28, 1977

The Solar Building Test Facility located at the Langley Research Center in Hampton, Virginia currently utilizes a 1180-m^2 solar collector field to help heat and cool a 4650-m^2 (50,000-ft^2) office building. The solar collector field contains seven collector designs. Before operation in the field, the experimental performances (thermal efficiencies) of the seven collector designs were measured in an indoor solar simulator at the Lewis Research Center in order to provide a baseline for later comparison with actual field test data. The simulator test results are presented for the collectors as received and after several weeks of outdoor exposure with no coolant (dry operation. Six of the seven collector designs tested showed substantial reductions in thermal efficiency after dry operation.

ST79 30060 Experiences With Solar Grain Drying and Livestock Shelter Heating

Lasswell, D.
Nat'l Solar Grain Drying Conf. Proc. Champaign, IL Jan. 11, 1977
CONF-770140 p. 160-161

The roof of the swine building is used as a bare-plate solar collector. The solar air chamber was created by laying 8/10-inch urethane foam insulation boards running the length of the building. The solar-heated air is used to ventilate the swine building or directed to grain drying bins.

ST79 30061 Summary Report on the Northview Junior High School Solar Energy Demonstration Project

Merrill, G.L.
Honeywell, Inc., Minneapolis, MN
Proc. of 1977 Flat-Plate Solar Collector Conf. Orlando, FL
CONF-770253 p. 447-476 Feb. 28, 1977

The design, installation, operation, and evaluation of a solar energy system installed at Northview Junior High School, Brooklyn Center, Minnesota are covered. The system was operational in May of 1974 and was evaluated under contract from ERDA for one year. Qualitative evaluations are still being conducted. The system was deisgned around a 5000-ft^2 collector array and is used to supply solar heated fluid to heat exchangers located within the building. The evaluation of the system included the following: determining the amount of effective solar energy collected, determining the utilization of the different solar system operating modes, evaluating cold weather heating performance, evaluating the system for solar heating potential, and determining the nature and level of solar flux values available for the year. The system was designed to provide energy for: (1)space heating (fresh and/or return air); (2)swimming pool water heating; and (3)domestic water heating. Over the one-year test period the system provided 629,000,000 BTU of collected energy with an average collector efficiency of 44 percent. The energy distribution was 54 percent for space heating, 25 percent for pool water heating, and 21 percent for domestic water heating.

ST79 30062 Experience With Solar Collector Designs, Operations, and Maintenance

Moseley, T.D.
Terrell E. Moseley, Inc., Lynchburg, VA
Practical Application of Solar Energy to Wood Processing Workshop Proc. Blacksburg, VA
CONF-770152 p. 7-13 Jan. 6, 1977

Three areas are covered: Typical problems encountered in operating and maintaining solar systems; design considerations as they affect maintenance; and importance of routine maintenance. The five basic components of a solar system are considered: (1)energy collection; (2)energy transport; (3)energy storage; (4)energy distribution; and (5)control. The very simplest air dryers consist of a transparent enclosure and have the first four components inherent in the design. Such a system is often referred to as a passive one. Control of temperature can be by nature or by ventilators. A more sophisticated system can have complex components controlled by computers. These can be both wet and dry or a combination of the two; examples are given.

31,000 COMPUTER MODELS, DEMONSTRATIONS

ST79 31001 Analysis and Design of Solar Buildings Using the CAL-ERDA Computer Programs

Argonne Nat'l Lab., Argonne, IL
Int. Solar Energy Congress New Delhi, India Jan. 16, 1978
Avail:NTIS, CONF-780114-9 p. 6

A new set of computer programs have been developed which are capable of rapid and detailed analysis of energy consumption in buildings. These computer programs allow an architect/engineer to study various design options including detailed computations of the thermal performance of solar collectors, heat storage apparatus, and conventional heating and cooling equipment. In order to allow a simplified manipulation of the many variables used to describe a building and to allow users the widest versatility in the design of solar buildings, a new user-oriented computer input language called BDL, a building design language, has been developed. This language is used to describe each component of a building, to analyze the input commands, and to notify the user of possible mistakes. BDL also controls data retrieval from a large set of libraries containing information on building components, materials, and operation schedules. It is also used to control the operation of the four primary computational programs which simulate the building load; its heating, ventilating, and air conditioning (HVAC) systems; the plant and solar equipment; and to compute economic parameters.

ST79 31002 Analysis of the Current Economic Feasibility of Solar Water and Space Heating

DOE, Div. of Solar Applications, Washington, D.C.
Avail:NTIS, DOE/CS-0023 Jan. 1978 p. 43

The current economic feasibility of solar water and space heating in four representative cities in the United States is analyzed. The four representative cities are Boston, Massachusetts; Washington, D.C.; Grand Junction, Colorado; and Los Angeles, California. The feasibility of solar water heating and combined water and space heating is examined separately for single-family detached homes and for multi-family apartment buildings. Using actual 1977 regional fuel prices and solar equipment costs, the solar systems are competed against conventional gas, fuel oil, and electric systems. The results are evaluated on the basis of three decision criteria; an identical analysis is then carried out assuming the passage of a solar income tax credit.

ST79 31003 Computer Sciences Research Status Report

Univ. of California, Lawrence Livermore Lab., Livermore, CA
Avail:NTIS, UCID-17720 p. 50 Feb. 3, 1978

Computer science research at LLL funded by the Department of Energy, Division of Basic Energy Sciences during FY77 focused on computer networks, primarily local networks. The work in this area centered in four areas: modeling and simulation, protocol development for local networks, local network statistics gathering system, and ERDA/DOE network investigators group participation. The work performed during the past year in each of these areas is briefly summarized. Slides and reports of interest are included as appendices. In addition to the network research work, two specialized architecture studies were partially supported by the DBES funds: performance studies for array processors and a study of data flow architecture.

ST79 31004 Computer Simulation of Steady State Performance of Air-to-Air Heat Pumps

Oak Ridge Nat'l Lab., Oak Ridge, TN
Avail:NTIS, ORNL/CON-16 p. 104 March 1978

A computer model by which the performance of air-to-air heat pumps can be simulated is described. The intended use of the model is to evaluate analytically the improvements in performance that can be effected by various component improvements. The model is based on a trio of independent simulation programs originated at the Massachusetts Institute of Technology Heat Transfer Laboratory. The three programs have been combined so that user intervention and decision making between major steps of the simulation are unnecessary. The program was further modified by substituting a new compressor model and adding a capillary tube model, both of which are described. Performance predicted by the computer model is shown to be in reasonable agreement with performance data observed in our laboratory. Planned modifications by which the utility of the computer model can be enhanced in the future are described. User instructions and a FORTRAN listing of the program are included.

ST79 31005 Sandia Laboratories Technical Capabilities: Computation Systems

Sandia Labs., Albuquerque, NM
Avail:NTIS, SAND-77-0767 p. 25 Dec. 1977

This report characterizes the computation systems capabilities at Sandia Laboratories. Selected applications of these capabilities are presented to illustrate the extent to which they can be applied in research and development programs.

ST79 31006 Simple Empirical Method for Estimating the Performance of a Passive Solar Heated Building of the Thermal Storage Wall Type

Los Alamos Scientific Lab., Los Alamos, NM
2nd Nat'l Passive Solar Conf. Proc. Philadelphia, PA March 15, 1978
Avail:NTIS, CONF-780337-2 p. 8

Two methods are presented for estimating the annual solar heating performance of a building utilizing a passive thermal storage wall of the Trombe wall or water wall type with or without night insulation and with or without a reflector. The method is accurate to ± 3 percent as compared with hour-by-hour computer simulations.

ST79 31007 Solar Energy System Testing: Some Experiences With Minicomputers

Sandia Labs., Albuquerque, NM
Seminar on Testing Solar Energy Materials and Systems Washington, D.C.
Avail:NTIS, CONF-780050-1 p. 8 May 22, 1978

For the past few years Sandia Laboratories has been involved with testing different components and systems associated with solar (and wind) energy studies. Sandia now has five minicomputer-based controllers which aid in data acquisition and control of such projects as the solar total energy project, photovoltaic test project, solar collector project, solar thermal test facility (power tower), and the vertical axis wind turbine. The experiences associated with these projects have given some insight into developing a "philosophy of application" of minicomputers or microprocessors to this type of testing. In this paper, such ideas as versatility of hardware and software and "distributed" systems are explained with the purpose of outlining this philosophy.

ST79 31008 Seasonal Stochastic Simulation Experiments on Solar Air Conditioning Systems

Anand, D.K.; Allen, R.W.; Bazques, E.O.
Univ. of Maryland, College Park, MD
8th Annual Conf. on Modeling and Simulation, Proc. Pittsburgh, PA
Instrument Soc. of Am., Pittsburgh, PA April 21, 1977 p. 459-467

Real weather data and stochastic weather models are used in simulating the performance of solar powered air-cooled and water-cooled air conditioning systems for an entire cooling season. The simulation included various parametric models for the absorption machinee and variation of collector area and mass flow rates. It is concluded that the stochastic data yield satisfactory results for various system configurations while permitting very inexpensive simulations.

ST79 31009 Data Acquisition and Processing With a HP 9825 Desk Top Calculator Controlled Instrumentation System in the Los Alamos Solar Mobile/Modular Home

Hedstrom, J.C.
Los Alamos Scientific Lab., Los Alamos, NM
Conf. on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems, Proc. Washington, D.C. April 3, 1978
Avail:NTIS, CONF-780432-1 p. 9

Data have been taken in the solar mobile/modular home with a Hewlett Packard 9825 calculator from October 1976 until the present. The data system and data reduction techniques are described and some of the typical results obtained are presented.

ST79 31010 The Building Loads Analysis and System Thermo-Dynamics (BLAST) Program, Volume 2, Reference Manual, Final Report

Hittle, D.C.
Army Construction Engng. Res. Lab., Champaign, IL
Avail:NTIS, AD-A-048982 Dec. 1977

The Building Loads Analysis and System Thermodynamics (BLAST) Program is a sophisticated set of subprograms for predicting energy consumption in buildings. The four major subprograms are: the input processor, which parses the high-level input language and sets up the building systems; plant descriptions; the building loads subprogram, which computes the hourly space load in a building or zone based on the user's description of the building; zone and hourly weather data; the air distribution system simulation subprogram, which calculates the coil energy demands, fan power, etc., based on the user's description of the plant and the hourly coil loads calculated by the previous subprogram; and the central energy plant simulation subprogram, which calculate energy consumption of a central solar total energy plant based on the user's description of the plant and the hourly solar load calculated by the previous subprogram, and performs a life-cycle cost analysis of the plant. In addition to conventional boiler-chiller equipment, the central energy plant subprogram includes solar heating and cooling systems, total energy systems, and commercial utility systems. The program is written in Control Data Corporation (CDC) FORTRAN extended, Version 4, and can be used on CDC 6000/7000 series computers without major modifications. This volume is the reference manual for BLAST and contains descriptions of all BLAST subprograms, as well as structural algorithm charts where appropriate.

32,000 THERMAL STORAGE

ST79 32001 Electrical Block Storage Air Heating Plant

German (FRG) Patent no. 2,233,413/B April 28, 1977 p. 2 In German
Licentia Patent-Verwaltungs-GMBH, Frankfurt Am Main, Germany, F.R.

The invention concerns an electrical block storage air heating plant, in which during discharge of the block storage heater by pumped air, no air flow from the inside to the outside can arise in the block storage heater, which would entail heat losses. Neither is the fan in contact with hot air from the block storage heater and thermally stressed by it. For this purpose the block storage heater is arranged in an air-tight chamber, which has air introduced from the outside by a fan during discharging and from which the block storage heater obtains the air to be heated via an air inlet channel. The heated air is taken from the block storage heater to the rooms to be heated through hot air channels. According to the invention the chamber is always at a higher pressure relative to the block storage heater during discharge, via an inlet pipe connected to the pressure side of the fan.

ST79 32002 Energy Storage, Answer of the Federal Government to a Question by Members of The Bundestag, Printed Matter 3/772

Heger, Bonn-Bad Godesberg, Germany, F.R.
p. 12 1977 In German

In energy storage the problems are not technical, but are economic. For liquid fuels, storage in storage lakes or caves is considered. Gaseous energy carriers are stored above ground in so-called gasometers or underground in empty natural gas-oil fields, in artificially constructed aquifer stores or in caves in salt mines. For secondary energy storage one uses mechanical energy stores with storage of rotational energy (flywheels - gyroscopic stores), hydraulic pumped storage (pumped storage schemes), compressed air storage schemes (energy storage in the form of energy of compression), and thermal storage (hot water storage, night store heater). For the storage of electrical energy, only electro-chemical storage (batteries) is worth considering in practice. For the storage of thermal energy, liquids (water, oil), rockfill, metals and hydrated salts (latent heat storage) can be considered. In connection with the use of solar energy, hydrogen is being discussed as secondary energy carrier, and investigations on hydrogen storage are under way.

ST79 32003 Experimental Results of Gravel Heat Storage

Am. Soc. of Automotive Engnrs., St. Joseph, MI
Paper no. 77-5011 p. 20 1977

The paper reports on a modular solar energy storage system applicable both in retrofitting existing greenhouses and in new construction. There is enough space within or under a greenhouse to use gravel to store the excess heat drawn off from the greenhouse ridge. The gravel units may be designed in modular units and used to retrofit existing greenhouses. New greenhouse shapes and the use of insulation techniques may reduce normal heat losses by 50 percent. It appears that 25 percent of the remaining heat load can be obtained by collection, storage, and retrieval of solar energy using the greenhouse as the only means of collection. The combination would greatly reduce the heating requirements of greenhouses.

ST79 32004 Heat Storage Furnace

German (FRG) Patent no. 2,250,952/B
Kueppersbusch und Soehne A.G., Gelsenkirchen, Germany, F.R.
p. 4 April 28, 1977 In German

The invention concerns a heat storage furnace, in which hot air taken through the core of the store is to be mixed with cold air taken through a by-pass channel so that a nearly constant air mixture temperature is produced. The cross-section of the opening of the by-pass channel can be changed by a flap, which is controlled by a bimetal strip situated in the outgoing air flow. According to the invention, one leg of the U-shaped bimetal strip is situated immediately in the temperature region of the store core, and the other leg is situated in the path of the air taken through the by-pass. With the store core fully charged, the outlet cross-section of the by-pass channel is open to the fullest extent and the outlet opening for the air taken through the store core is blocked as far as possible. If the store core temperature falls and lowers the temperature of the heated air, the U-shape of the bimetal strip opens so that the flap reduces the opening cross-section of the by-pass channel and simultaneously more air enters the mixing channel from the store core.

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ST79 32005 Heat Store For Solar Energy Utilization in Heating Systems and Water Heating

Stuttgart Univ., Germany, F.R., Inst. Fuer Kernenergetik und Energiesysteme
Proc. of Conf. on Energy Policies Forum of the Landesregierung
Stuttgart, F.R. Germany p. 25 May 9, 1977
Avail:NTIS, CONF-770592-4 US Sales Only In German

After a survey of the main parameters for heat store construction, a new latent heat store concept is described which takes account of the experience with stores in existing solar homes. The new concept is based on a modular construction. Each module has a finned heat pipe partitioned into three compartments (store space, heat source region, and heat sink region). The space between the fins is filled with a storage material which changes from the solid to the liquid phase when heat is added. The test model was operated with paraffin and water. Finally, a proposal is made for an integration of the latent-heat store concept into a solar space and water heating system.

ST79 32006 Solar Energy Heated Closed or Open Container For General Purpose

German (FRG) Patent no. 2,608,328/A
p. 8 Sept. 1, 1977 In German

The invention has the purpose of providing containers in which solid, liquid, or gaseous materials can be stored and which are so arranged that they can be heated or kept at a certain temperature using solar energy. The containers are constructed wholly or partly from two or more walls. The outer jacket is made of material having great transparency to light and low reflecting effect. Below the jacket there are gas cushions. The actual absorber layer is situated below this. The back of the container can consist of heat insulating material. Finally some applications for such containers are described.

ST79 32007 Thermal Energy Storage Tank

Agency of Industrial Science and Tech.
US Patent no. 4,088,183 p. 6 March 30, 1977
Avail:Patent Office

A thermal energy storage tank charged with a phase changeable thermal energy storage material produces a partial pressure variation due to the flow of a heat transfer medium, when passing through the thermal energy storage material. An attempt is made to provide the uniform phase changeable of the thermal energy storage material by passing the heat transfer medium therethrough, over the throughout of the thermal energy storage material by providing a variety to the flow direction of the heat transfer medium. For instance, according to the achievement of uniform flow of heat transfer medium in the vertical direction, there may be attained uniform phase changeable both in an upper portion and in a lower portion of the thermal energy storage material.

ST79 32008 Thermal Storage in Grain Drying

Eckhoff, S.R.; Okos, M.R.
Purdue Univ., W. Lafayette, IN
Solar Grain Drying Conf. Proc. Champaign, IL Jan. 11, 1977
CONF-770140 p. 233-249

There is a need for the utilization of thermal storage with solar supplemented and natural air grain drying. Thermal storage can increase the confidence of such low temperature drying procedures to satisfactorily replace the existing high-temperature drying techniques. Focus should be given to the development of long-term storage systems which are low in cost and fit the requirements for grain drying. Particular attention should be given to the use of an encased saturated soil thermal storage system because of the inexpensive materials needed for construction. Research is needed which will give experimental and analytical results of the feasibility of such a system for use with grain drying.

ST79 32009 Plastic Trays Salt Away Solar Heat

Goodman, E.
Popular Science V 213 No. 10 p. 131

No abstract available.

ST79 32010 Heat Storage in Phase Change Materials for Solar Grain Drying

MacCracken, C.D.
Calmac Mfg. Corp., Englewood, NJ
Nat'l Solar Grain Drying Conf. Proc. Champaign, IL Jan. 11, 1977
CONF-770140 p. 250-254

A grid of small flexible plastic tubes rolled into a spiral and put into a cylindrical plastic tank filled with phase change materials is discussed for use in solar grain drying.

ST79 32011 Super Storage for Solar Heat

Miller, C.A.
Mechanix Illustrated V 74 No. 10 p. 40 Oct. 1978

No abstract available.

33,000 ARCHITECTURAL CONSIDERATIONS

ST79 33001 Energy Conservation and Window Systems, Conservation Paper Number 56

Federal Energy Administration, Washington, D.C.
Avail:NTIS, FEA/D-76/299 July 1976

An assessment is made of the role of the architectural window as an important factor in reducing energy consumption for residential and commercial climate control. The cost-effectiveness of many existing and modified window systems is evaluated. Some of the suggestions, if implemented, would cost-effectively reduce energy consumption while maintaining high aesthetic standards.

ST79 33002 Energy Efficiency in Denver...With a Big Skylight, Two Solar Windows, and Ingenious "Skyshafts"

Sunset V 161 p. 108 Sept. 1978

No abstract available.

ST79 33003 Illinois House

Am. Soc. of Automotive Engnrs. St. Joseph, MI
Paper no. 77-4002 1977 p. 7

The Illinois House is average size, 1568 ft^2. The house itself is designed to be an efficient solar collector-storage unit with super-insulation and south triple-glazed windows, but without applied solar hardware. The house has extremely low energy requirement. Computer simulations predict annual need of 10,000,000 BTU from the heating system for the Illinois House in climate for Madison, Wisconsin, 1961, 7564 degree days (a heat requirement of about 1 BTU/ft^2/DD). Same size house built to HUD-MPS standards has a predicted need of 35,000,000 BTU per year. Heat requirements are based upon air change rate of .5/hour and internal heat gain of 68,000 BTU/day (15 kWh and 2 persons).

ST79 33004 Implications of Energy Conservation on Housing Design

Hardy, A.
Univ. of Newcastle-upon-Tyne, England
Heat. Vent. Engng. V 52 No. 608 p. 20,22 May 1978

A brief review is given of some recent research in housing energy conservation. Heat loss by infiltration and ventilation, ventilation systems, and domestic hot water supplies are discussed.

ST79 33005 Energy Efficient Skylight Construction

Jentoft, A.P.; Couture, P.A.
US Patent no. 4,073,097 Feb. 14, 1978
Avail:Patent Office

An energy efficient skylight construction is described. A skylight cover is secured by a frame to a curbing comprised of an insulating core, the interior and exterior surfaces of which are covered by noncombustible shields separated along the upper and lower surfaces of the curbing by a gap which serves as a "thermal break" between the highly conductive material, such as foam or glass fibers, that is both absorptive of moisture and resistant to the passage of air. The frame is secured to the outward portion of the curbing and includes a flange extending inward across the gap between the shields, which serves as a gutter to collect condensation which drips off the glazing. The inward portion of the flange is covered with an insulating gasket which prevents condensation from forming on the flange and which prevents the warmer, more moisture laden, inside air from reaching the cold underside of the gutter flange or the edge of the outerskin. The core insulation is inserted without adhesives into the assembled inside skin and then the exposed surface of the insulation is bonded to the inside surface of the outer skin.

ST79 33006 High Performance Solar Control Office Windows

King, W.J.
Kinetic Coatings, Inc., Burlington, MA
Avail:NTIS, LBL-7825 Dec. 1977

Investigations conducted over a nine-month period on the use of ion beam sputtering methods for the fabrication of solar control windows for energy conservation are described. Principal emphasis was placed on colored, reflecting heat rejecting office building windows for reducing air conditioning loads and to aid in the design of energy conserving buildings. The coating techniques were developed primarily for use with conventional absorbing plate glass such as PPG Solarbronze, but were also demonstrated on plastic substrates for retrofit applications. Extensive material investigations were conducted to determine the optimum obtainable characteristics, with associated weathering studies as appropriate , aimed at achieving a 20-year minimum life. Conservative estimates indicate that successful commercialization of the windows developed under this program would result in energy savings of 16,000,000 barrels of oil/year by 1990 if installation were only 10 percent of new commercial building stock. These estimates are relative to existing design for energy conserving windows. Installation in a greater percentage of new stock and for retrofit applications could lead to proportionately greater energy savings. All such installations are projected as cost-effective as well as energy-effective. A secondary program was carried out to modify the techniques to yield thermal control windows for residential applications. These windows were designed to provide a high heat retention capability without seriously affecting their transmission of incident solar radiation, thereby enhancing the greenhouse effect. This part of the program was successful in producing a window form which could be interchanged for standard residential window material in a cost and energy-effective manner. The only variation from standard stock in appearance is a very light rose or neutral gray coloring.

ST79 33007 Heat Insulating Structure

Lemercier, G.
US Patent no. 4,055,464 Oct. 25, 1977
Avail:Patent Office

Structural elements which are each formed by two sectional members of substantial length are mounted in juxtaposed relation in the line of extension of each other. The two sectional members of each structural element are engaged one inside the other with a small clearance space between their parallel faces. A flexible packing of metallic material is enclosed between the sectional members so as to ensure that they are capable of working in pairs both along the length of said members and in the direction of engagement of these.

34,000 PASSIVE SOLAR ENERGY

ST79 34001 Heating Buildings by Winter Sunshine

Davies, M.G.
Univ. of Liverpool, England
CONF-7504141 1975

Over a season the viability or otherwise of solar construction is demonstrated by finding whether an increase in area of solar wall decreases or increases the total energy requirement over the season. The direction of this change depends upon what indoor temperature is chosen and the distribution of criterion temperatures. Estimates of power consumption are made for the solar heated school, St. George's, Wallasey. They are made on the basis of weather patterns in the area during 1960/1969. It is concluded that some, though modest, savings should be possible in the Wallasey area using a solar wall similar to that used in the school. Larger savings should be possible. These conclusions apply also to housing.

ST79 34002 Active and Passive Systems, Solar Heating

Watt, C.
House Beautiful V 120 p. 50 Oct. 1978

No abstract available.

ST79 34003 Passive Solar Heating and Cooling Systems

Yellott, J.T.
Arizona State Univ., Tempe, AZ
Symp. on Passive Systems for Solar Utilization Halifax, NS, Canada
Proc. of Symp. ASHRAE J. V 20 No. 1 p. 60-67 Jan. 1978

There are three principal passive heating systems, using the following concepts: Type 1 - sun + space + building mass storage; Type 2 - sun + storage mass + space; and Type 3 - sun + natural convection + storage. Type 1 is exemplified by the David Wright residence. Type 2 examples are the Trombe wall residences and the Steve Baer Drumwall houses. The Skytherm houses are a Type 2 which can both heat and cool. Type 3 includes the thermosyphon water heater and the Paul Davis house. Details and data are included for some of these houses.

35,000 THERMAL LOAD COMPUTATIONS

ST79 35001 Building Environmental Systems Evaluation for the National Security and Resources Study Center

Los Alamos Scientific Lab., Los Alamos, NM
Avail:NTIS, LA-7141-T p. 159 Feb. 1978

A method is presented for manually calculating the approximate annual energy requirements of the heating, ventilating, and air conditioning systems of a 60,000-ft^2 solar heated and cooled building. In addition to a solar source, several energy conservation schemes including return air cooled luminaires, reduced lighting levels, reduced outside air changes, hot and chilled water storage, and heat recovery were incorporated into the building systems design and the impact on energy consumption of several design decisions is investigated.

ST79 35002 Solar Energy Transmission Through Two Transparent Covers

Am. Soc. of Automotive Engnrs., St. Joseph, MI
Paper no. 77-3006 p. 16 1977

The paper presents a method to calculate the transmittance of solar collector cover systems which employ one or two covers. A procedure to calculate the direct and diffuse radiation on a surface of any orientation, given the hourly insolation, is also provided. Experimental measurements are included to show accuracy of the method.

ST79 35003 Multi-Staged Thermal Survey of Housing

Hazard, W.
Hazard and Associates, Austin, TX
Proc. of 3rd Biennial Infrared Info. Exchange AGA Corp., Secaucus, NJ 1977

A study of energy transfer through building enclosures, based on airborne radiometry, is reported. The type and quantity of materials used, the quality of construction and certain design features are estimated by remote sensing procedures. The objects of importance are insulation, infiltration, glass, orientation and external shading, and building shape and thermal mass. The study determined how a public utility company might work with homeowners to conserve energy. Particularly, the analysis concerned insulation and infiltration factors which affected heat gain or heat loss; 22,577 structures in the city of Garland, Texas were observed by aerial radiography. The AGA thermovision system was used on the ground to measure energy losses from each of 24 test houses. Conclusions about overall heat loss in Garland were that approximately two percent of the single-family structures in the city exhibit noticeable loss. Eight percent of the multi-family units and nearly 20 percent of the commercial and industrial buildings show a similar significant degree of heat loss/gain due to insulation, glass, and air infiltration problems.

ST79 35004 Practical Application of Infrared Inspection to Residential Dwellings

Lynch, J.M.
Energy Conservation Consultants, Inc., Bloomington, MN
Proc. of 3rd Biennial Infrared Info. Exchange AGA Corp., Secaucus, NJ 1977

Energy conservation consultants have been offering infrared inspection services to residential homeowners and insulation contractors for nearly a year. Using this technique, we can provide the user of our service with on-site qualitative analysis of his energy losses. The basic inspection, interior or exterior, usually takes one hour or less. Interior inspections are becoming increasingly the trend, although exterior inspection is still important for identifying gross defects. Most high energy losses produce significant temperature variations allowing for easily identifiable detection. Variations in building materials and weather conditions must always be taken into account but these do not inhibit practical inspection from being cost-effective.

ST79 35005 Application of Airborne Infrared Technology to Monitor Building Heat Loss

Tanis, F.J.; Sampson, R.F.
Environ. Res. Inst. of Michigan, Ann Arbor, MI
Proc. of 11th Int. Symp. on Remote Sensing of Environ., V 2
CONF-770478-P2 1977

During the 1975-76 winter heating season ERIM conducted studies to test the application of airborne infrared technology to the requirements for energy conservation in buildings. Quantitative airborne data of the city of Ypsilanti, Michigan were collected and processed to identify roof temperatures. A thermal scanner was flown at an altitude of 1,200 feet with two thermal bands 8.2 to 9.3 MUM and 10.4 to 12.5 MUM recorded by an analog system. Calibration was achieved by standard hot and cold plates. Using a thermal model to interpret ceiling insulation status, environmental factors were found to influence the relation between roof temperature and insulation. These include interior and sky temperatures, roofing materials, and the pitch and orientation of the roof. A follow-up mail survey established the ability to identify insulated and uninsulated houses from the airborne infrared data.

36,000 DOMESTIC WATER HEATING

ST79 36001 Double-Exposure Collector System for Solar Heating Applications

Drexel Univ., Philadelphia, PA
Int. Solar Energy Congress New Delhi, India Jan. 16, 1978
Avail:NTIS, CONF-780114-6 p. 5

A retrofit solar water heating system has been installed in a three-story apartment building at Drexel University. The system employs two conventional collector banks mounted at the latitude angle for Philadelphia of 40° from the horizontal and two double-exposure collectors (DEC's) mounted vertically in mirrored enclosures. Although the DEC units are being used for year-round domestic water heating for the building, they are designed to provide maximum output in the winter and are therefore well-suited to solar space heating applications. The performance of the DEC units relative to conventional collectors has been calculated.

ST79 36002 Effects of Thermal Stratification in Water Storage Tank for the Performance of a Solar Hot Water System

Alabama Univ., Huntsville, AL
Southeastern Seminar on Thermal Sciences Raleigh, NC April 6, 1978
Avail:NTIS, CONF-780408 p. 17

Numerical simulation of a solar hot water application for an apartment has been carried out by using the TRNSYS computer program with a fully mixed and a fully stratified water storage tank model. Simulation results show that (1) solar energy collection efficiency can be increased up to approximately 6 percent by using a fully stratified model compared with that of a fully mixed model; (2) the effects of temperature stratification inside the water storage tank should be greater for lower efficiency solar collectors; and (3) the difference of the total solar energy collected between a mixed and a stratified model depends strongly on the temperature stratification regardless of the system parameters.

ST79 36003 Equipment For Heating Water by Solar Radiation

German (FRG) Patent no. 2,602,320/A
p. 8 July 28, 1977 In German

A black pipe consisting of flexible material with water flowing through it which acts as absorber for solar radiation is discussed. The pipe is surrounded by a protecting pipe which permits light to pass through. The intermediate space between absorber and protective pipe is evacuated. The whole hose system is wound spirally in one plane. The back has a layer of reflecting material on it. Apart from this, the whole system is privided with a covering which is translucent to solar radiation.

ST79 36004 Equipment for Hot Water Production From Solar Radiation

German (FRG) Patent no. 2,558,767/A
p. 8 July 7, 1977 In German

The solar collector described consists of the usual blackened absorber plate with suitable equipment for removing thermal energy. The absorber is covered by a glass plate and the back has thermal insulation. By using flaps fitted at the side of the collector box the absorber can be covered, if no energy conversion is required. The insides of these flaps are covered with mirrors and can be set by setting motors, so that additional solar radiation reaches the absorber. Also the whole collector unit can be made to follow the sun.

ST79 36005 Flat-Plate Collectors and Solar Water Heating

Int. Solar Energy Soc., London, England
p. 27 1977

The possibilities for solar energy in the United Kingdom are explored. The following subjects are covered: flat-plate collectors, solar heating systems, solar energy availability, estimating the benefits of solar water heaters, the use of flat-plate collectors for space heating, building regulations and planning controls, and economic considerations. Included in appendices are: flat-plate collector thermal performance characteristics, and selective surfaces performance and methods of preparation.

ST79 36006 Guide to Sizing and Economics of Solar Water Heating in Florida Residences

Florida Solar Energy Center, Cape Canaveral, FL
p. 5 $1.25

This is a consumer book explaining the various aspects of a solar water heating system. Two different types of domestic water heating systems are explained: the open, direct water system and the closed-loop or antifreeze system. The typical flat collector is explained with a diagram of it, as well as the absorber tubing construction. Solar water heating components are examined. Sizing of the system is discussed in terms of the hot water demand and the solar system sizing. Graphs are included of Florida climate, collector tilt, and orientation. To estimate the economics of the solar hot water system for the homeowner, calculations are made of the solar savings in terms of the long-term purchase and the short-term purchase. Buying, installation, and maintenance tips are included. A bibliography, appendix, and glossary of terms are included at the end of the text.

ST79 36007 New and Retrofit Solar Hot Water Installations in Florida, January-June 1977

Florida Solar Energy Center, Cape Canaveral, FL
Avail:NTIS, HCP/I5663-01 p. 25 April 1978

The purpose of this project was to ascertain the number of solar hot water installations in new buildings versus the number retrofitted to existing buildings in Florida during the January to June period of 1977. The methodology was to survey all installations started, in progress, or completed during that period. A by-product of the survey is a comprehensive list of manufacturers and another of distributors and installers in Florida. The survey excludes space heating and cooling, and pool heating applications. However, the latter is being considered for a separate survey. Installations included are in the single-family and multi-family residential, commercial, industrial, and public sectors. In the single-family residential sector, care has been taken to determine a new or retrofit breakdown, average square footage of collector per installation, average cost per square foot of collector in Florida, and subsequently, using F-chart and system sizing programs developed at the center, the fraction of load supplied by solar and its equivalent barrels of oil saved per year. In the multi-family residential, commercial, industrial, and public sectors specific information on each installation has been provided. This information includes new or retrofit, ownership, type of collector and manufacturer, square footage of installation, design percentage energy by solar, auxiliary fuel, system cost, and federal grants, if any.

ST79 36008 Two-Week Training Program for Building Solar Thermosiphon Domestic Water Heating Systems

Univ. of California, Lawrence Livermore Lab., Livermore, CA
Avail:NTIS, UCID-17595 p. 73 Aug. 31, 1977

Lecture outlines and handouts are presented for a two-week course on building a solar thermosiphon system for home water heating. The course covers solar energy theory but focuses on practical skills required to build such a system: brazing, soldering, carpentry, sizing pipes, selecting pumps, sizing collectors, and determining domestic hot water needs. This course is based on one taught at San Jose City College, August 8-19, 1977 for the CAL/NEVA Community Action Agency weatherization crews.

ST79 36009 Economics of Solar Domestic Water Heating With Flat-Plate Collectors

Florida Solar Energy Center, Cape Canaveral, FL
Proc. of 1977 Flat-Plate Solar Collector Conf. Orlando, FL
CONF-770253 p. 645-652 Feb. 28, 1977

The economics of solar domestic water heating primarily depend on the solar system installed cost, the expected present and future monthly savings in utility bills, and the form of financing the system. Secondary variables affecting the economic outcome are system maintenance costs and applicable taxes. The homeowner is given a simplified method for determining solar system net lifetime savings and payback periods for different forms of financing. Since the initial system cost varies widely, it is treated as a parameter. The monthly savings in utility bills depends on the percent of energy supplied from solar, the hot water demand, and the cost of auxiliary energy. The monthly savings is also treated as a parameter, but an estimate of it is given as a function of demand and type of auxiliary fuel used. Graphs are presented showing solar system lifetime savings and payback period as a function of system cost with monthly fuel savings as a parameter for different forms of financing. Effects of financing incentives are also examined.

37,000 INSOLATION AND INSTRUMENTS

ST79 37001 Commonwealth Scientific and Industrial Research Organization Solar Energy Studies, Solar Radiation Incident on Inclined Surfaces in Melbourne

Commonwealth Scientific and Industrial Research Org., East Melbourne, Australia
Avail:NTIS, SR-MEL-1 p. 99 1977

A technique is used which will compute the radiation incident on a plane inclined at any angle and oriented in any direction, using only the measured hourly values of global radiation on a horizontal surface. Program Prerad as used for the preparation of these tables, predicts total insolation on a selected plane, either in the form of hourly values of radiation day by day or daily averages month by month for a number of years.

ST79 37002 Computations of Solar Insolation at Boulder, Colorado, Technical Memo

Nat'l Environ. Satellite Service, Boulder, CO
Avail:NTIS, NOAA-TM-NESS-93 p. 20 Sept. 1977

Computations of total solar insolation at a latitude and altitude appropriate for Boulder, Colorado were made with respect to solar declination angle. These computations were made for three hypothetical orientations of a collecting surface: a horizontal plane, a plane inclined perpendicular to the sun's rays at local noon, and a surface that is adjusted on a continuous basis so that it is always perpendicular to the solar rays. These calculations are made for each sunlight hour, the results of which are integrated with respect to time to provide energy per day under each of the three cases as functions of solar declination angle.

ST79 37003 Data Acquisition and Monitoring System for Los Alamos National Security and Resources Study Center

Los Alamos Scientific Lab., Los Alamos, NM
Conf. on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems Washington, D.C. April 3, 1978
Avail:NTIS, LA-UR-78-677 p. 6

The National Security and Resources Study Center, a modern, three-level building containing 5574 m^2 of temperature controlled space and an integral solar energy heating and cooling system is in operation at Los Alamos, New Mexico. The instrumentation system used to measure the energy production (solar energy system) and consumption (HVAC system) in all the building operating modes is described. Included are descriptions of the sensors (temperature, mass flow, power, etc.) and the data acquisition system.

ST79 37004 Evaluation of Models to Predict Insolation on Tilted Surfaces

NASA, Lewis Res. Center, Cleveland, OH
Avail:NTIS, DOE/NASA/1022-28 p. 31 March 1978

An empirical study was performed to evaluate the validity of various insolation models which employ either an isotropic or an anisotropic distribution approximation for sky light when predicting insolation on tilted surfaces. Data sets of measured hourly insolation values were obtained over a six-month period using pyranometers which received diffuse and total solar radiation on a horizontal plane and total radiation on surfaces tilted toward the equator at 37° and 60° angles above the horizon. Data on the horizontal surfaces were used in the insolation models to predict insolation on the tilted surface; comparisons of measured versus calculated insolation on the tilted surface were examined to test the sky light approximations. It was found that the Liu-Jordan isotropic distribution model provides a good fit to empirical data under overcast skies but under underestimates the amount of solar radiation incident on tilted surface under clear and partly cloudy conditions. The anisotropic-clear-sky distribution model by Temps and Coulson provides a good prediction for clear skies but overestimates the solar radiation when used for cloudy days. An anisotropic-all-sky model was formulated in this effort which provides excellent agreement between measured and predicted insolation throughout the six-month period.

ST79 37005 On the Nature and Distribution of Solar Radiation

Watt Engng. Ltd., Cedaredge, CO
Avail:NTIS, NCP/T2552-01 p. 265 March 1978

Radiation from the sun and the effects of the earth's atmosphere on the solar energy available over the United States are examined in detail. A model is developed which permits calculation of average values of direct normal insolation, diffuse insolation, and total horizontal (global) insolation. The inputs required are: (1)atmospheric moisture, (2)turbidity, and (3)cloud cover or percent sunshine. Insolation maps giving seasonal trends and annual average daily energy density values are presented for the direct normal term, the diffuse horizontal term, and the total horizontal (global) term. Comparisons are made between model outputs and observed values.

ST79 37006 Solar and Long Wavelength Energy Transmission of Materials

Am. Soc. of Automotive Engnrs., St. Joseph, MI
Paper no. 77-4013 p. 17 1977

Methods of measurement and results are presented for the most important radiant energy transmission characteristics of nine common materials that might be considered for covering greenhouses or solar collectors, and for 81 two-layer combinations of the materials. Long wavelength energy transmission rate is shown, as well as the average daily short wavelength energy transmission. The change in solar energy transmission for these materials and combinations, with angle of incidence between a normal to the material surface and the solar direct beam, is also shown. Measured values are presented for the percent of transmitted energy that is diffuse radiation below the cover material.

ST79 37007 Statistical Analysis of NOAA Solar/Weather Tapes, Program Summary, Final Report

JPL, Pasadena, CA
Avail:NTIS, JPL-5040-39 June 1977 p. 52

A major mission of the United States Coast Guard is the task of providing and maintaining maritime aids to navigation. These aids are located on and near the coastline and inland waters of the United States and its possessions. A computer program, design synthesis and performance analysis (DSPA) has been developed by the Jet Propulsion Laboratory to demonstrate the feasibility of low-cost solar array/battery power systems for use on flashing lamp buoys. To provide detailed, realistic temperature, wind, and solar insolation data for analysis of the flashing lamp buoy power systems, the two DSPA support computer programs sets: Merge and Stat were developed. A general description of these two packages is presented in this program summary report. The Merge program set will enable the Coast Guard to combine temperature and wind velocity data (NOAA TDF-14 tapes) with solar insolation data (NOAA Deck-280 tapes) onto a single sequential merge file containing up to 12 years of hourly observations. This Merge file can then be used as direct input to the DSPA program. The Stat program set will enable a statistical analysis to be performed of the Merge data and produce high or low or mean profiles of the data and/or do a worst case analysis. The Stat output file consists of a one-year set of hourly statistical weather data which can be used as input to the DSPA program.

ST79 37008 The Sun, Weather, and Climate

Weatherwise V 31 p. 144 Aug. 1978

No abstract available.

ST79 37009 Generation of a Typical Meteorological Year

Hall, I.J.; Prairie, R.R.; Anderson, H.E.; Boes, E.C.
Sandia Labs, Albuquerque, NM
Avail:NTIS, SAND-78-1096C 1978

Because of the need for a common meteorological data base for use in solar energy systems studies, a group has undertaken the task of developing a method for generating a typical meteorological year (TMY). The developed method has then been used to generate a TMY for each of the 26 Solmet rehabilitation stations that have hourly data. The meteorological measures used in the present study to select the TMY were: dry bulb temperature, dew point temperature, wind velocity, and solar radiations on a horizontal surface--standard year corrected. Most Solmet stations have data available over a 23-year period beginning in 1953 and extending through 1975. The process used to select a TMY for a given station involves selecting, by statistical methods, one typical meteorological month (TMM) for each of the 12 calendar months from the 23-year period and catenating the 12 months to form a TMY. Thus, the TMY for each station consists of 12 months of actual meteorological data selected from the long-term data base from that station, 23 years in most cases. A TMY at a given station could, for example, consist of January 1955, February 1966, March 1962, ... December 1973.

ST79 37010 North Sea Weather Data Review: 1971-1977

Kobus, L.C.S.; Guntur, S.R.
9th Annual Offshore Tech. Conf. Proc., V 2 Dallas, TX 1977

Offshore weather and sea conditions have been monitored on three Zapata offshore company jackup rigs covering the period of 1971-1977 in extensive North Sea drilling operations. This report presents the analysis of wind velocity and wave height distributions recorded at 57 different locations in the North Sea operating area. During the recording period, a maximum wind of 104 knots and a maximum wave of 66 feet were experienced. This data and its analysis can be of widespread value in planning evaluations for future North Sea offshore operations.

ST79 37011 Applications of Infrared Technology to Buildings

Sampson, R.E.; Wagner, T.W.
Environ. Research Inst. of Michigan, Ann Arbor, MI
Proc. of 34d Biennial Infrared Info. Exchange AGA Corp., Secaucus, NJ 1977

During the 1975-1976 winter heating season studies were conducted to test the applications of airborne and ground-bared infrared technology to the requirements for energy conservation in buildings. Quantitative airborne data of the city of Ypsilanti, Michigan were collected and processed to identify roof temperatures and subsequently, using a thermal model to interpret ceiling insulation status. Environmental factors which were found to influence the relation between roof temperature and insulation include interior and sky temperatures, roofing materials, and the pitch and orientation of the roof. A follow-up mail survey established the ability to identify insulated houses from the airborne infrared data. Ground-based thermovision surveys provided detailed information concerning construction and insulation conditions of small buildings. In particular, interior thermal images showed the location of wall and ceiling structural members, heat ducting, and sources of air infiltration. In application to a large steam heating system of the University of Michigan, the ground-based thermal imagery revealed defective steam traps with a projected energy savings valued at approximately $35,000.

ST79 37012 Effect of Ground Reflectance on Solar System Simulation

Wantoch, R.H.
Proc. of 1977 Flat-Plate Solar Collector Conf. Orlando, FL
CONF-770253 Feb. 28, 1977 p. 573-579

Flat-plate solar collector models and system design procedures use values of solar insolation calculated from measured insolation on horizontal surfaces. At any angle other than horizontal, the collector "sees" the ground. Most solar system performance calculation procedures assume ground reflectance is 0.2 for the entire year. The ground reflectance is about 0.7 during periods of snowcover. In the northern half of the United States there is sufficient snowcover during the winter months to affect solar system performance. The weather data of three stations in the northern half of the United States is analyzed to determine the amount of snowcover. Ambient temperature and percent sun sunshine coincident with snowcover are determined to assess the applicability of the performance calculation procedure. Performance curves are presented for standard calculation and snowcover correction with various loads and collector tilts from 0 to 90 degrees.

38,000 SWIMMING POOLS

ST79 38001 Guide to Collector Sizing and System Design Considerations for Solar Pool Heating in Florida

Florida Solar Energy Center, Cape Canaveral, FL
FSEC 77-9 p. 18 1977

Specific information is presented pertaining to system sizing using commercially available, plastic, low-temperature collectors for pool heating. Technical and hardware considerations unique to solar pool heating are also included. Medium temperature collectors, commonly employed for domestic water heating, are sometimes for pool heating and such applications are discussed briefly.

ST79 38002 Solar Heating For Swimming Pools: Economic Aspects

Brunt, P.; McNelis, B.
General Tech. Systems Ltd., Hounslow, England
UK-ISES Conf. on Solar Energy for Heating Swimming Pools
CONF-770156 p. 5-15 London, England Jan. 1977

The economics, in terms of the time necessary to repay capital investment, for two typical swimming pools are examined. Costs for a wide range of collectors are compared together with manufacturers recommendations as to the area of collector required for a given pool. Because of a lack of experimental data for collector performance, or comparison between different types, it is impossible to compile economic factors influencing the choice of collector. Using reasonable assumptions concerning the efficiency of a plastic collector, it is concluded that the solar heating of swimming pools is economically viable at the present time and any increase in fuel costs and/or reduction in system costs will make solar heating even more attractive.

ST79 38003 Installation and Control of Swimming Pool Solar Heating Systems

Spelman, N.A.C.
Robinson's Developments Ltd., Winchester, England
UK-ISES Conf. on Solar Energy for Heating Swimming Pools
CONF-770156 p. 23-34 London, England, UK Jan. 1977

Practical aspects of the application of solar energy to swimming pool heating are discussed. The factors affecting the design of collectors and systems and typical methods of controlling systems are considered in some depth.

39,000 GREENHOUSES

ST79 39001 Building and Using Our Sun-Heated Greenhouse; Grow Vegetables All Year Round

Garden Way Assoc's, Inc., Charlotte, VT
ISBN 0-88266-111-6 p. 153 $5.95 1977

Experience with unheated greenhouses in Maine and Vermont is described from the viewpoint of vegetarian, homesteading organic gardeners. The necessity of extending the growing season in the north in order to have fresh vegetables year-round is discussed. Locating, building, and maintaining soil and growing conditions in the greenhouse are included. Plants for each season in the greenhouse are discussed.

ST79 39002 Economics of the Attached Solar Greenhouse for Home Heating

Los Alamos Scientific Lab., Los Alamos, NM
Proc. of Conf. on Tech. for Energy Conservation Albuquerque, NM
Avail:NTIS, CONF-780109-5 p. 12 Jan. 23, 1978

For several years passive solar heating has been considered to be very attractive (economically and otherwise) for home heating in the United States. Unfortunately, passive systems are not as easily analyzed as active systems from an engineering and economic performance point of view. This problem is addressed and an economic assessment of the solar greenhouse is given. Using simple heat balance analysis, a greenhouse performance model is developed for assessing heat available for home space conditioning from an add-on solar greenhouse. This forms the basis for an engineering-economic model for assessing the economic viability of the add-on solar greenhouse for home heating. Model variables include climatic factors, local costs, alternate fuels, and system size. This model is then used to examine several locations in the United States for the economic attractiveness of the add-on solar greenhouse for space heating.

ST79 39003 Greenhouse Design, Construction, and Operation (Citations From the Engineering Index Data Base), Report for 1970-December 1977

NTIS, Springfield, VA
Avail:NTIS, NTIS/PS-78/0006 p. 130 Jan. 1978

Thermal environment, construction materials, and structural integrity of greenhouses are discussed in abstracts from worldwide literature. Topic areas cover the use of plastics and glass in greenhouse construction with emphasis on the use of plastics; heating with solar energy and waste heat; methods of reducing heat loss; and wind load and wind-induced heat transfer studies. Abstracts on air-supported greenhouses and combination greenhouse-solar distillation units are included.

ST79 39004 Greenhouse Solar Heating System Utilizing Underbench Rock Storage

Am. Soc. of Automotive Engnrs., St. Joseph, MI
Paper no. 77-3012 p. 19 1977

The design and operation of a greenhouse solar heating system utilizing partial shading in the greenhouse attic as the solar collector and an underbench rock-bed thermal storage is presented. This design renders the cost of the solar collector almost negligible since it utilizes the attic of the greenhouse as the collector. The only additional cost of the collector is the polypropylene shadecloth and the clear polycloth, both of which cost only a few cents per foot. This differs substantially from most solar heating systems where the cost of the solar collectors is the major cost of the system. The other primary advantage of this system over other solar greenhouse heating systems is that all components are contained within the greenhouse structure and do not appear to interfere with most greenhouse operations. Data from the present system, using solar heat only, show that the minimum greenhouse temperature was maintained approximately 20° F higher than ambient during 32° F weather and about 10° F above ambient during 50° F weather.

ST79 39005 Internal/External Solar Collectors For Greenhouse Heating

Am. Soc. of Automotive Engnrs., St. Joseph, MI
Paper no. 77-4008 p. 12 1977

Standard greenhouse construction materials and methods were used to assemble an air heating solar collection system. The system used in this investigation was somewhat different from one that would be used in a large commercial greenhouse because of the high ratio of surface area to ground area and therefore, heating load per unit of floor area. The external solar collectors, for example, were sized at 46 percent of the floor area of the experimental greenhouse. The interior collection system consisted of a fractional horsepower forward-curved centrifugal cabinet fan which pulled air from the two ridge areas areas of the greenhouse through clear polyethylene ducts. The external collection system was an array of four flat-plate air heating collectors inclined at an angle of 58° above the horizontal. Design features are low initial cost, simplicity of installation and operation, and high utilization factor. Initial results indicate that the system is suitable for "in-house" construction, installation, and operation, and that performance is equivalent to commercially available systems with approximately two to three times the initial cost.

ST79 39006 NOTI Solar Greenhouse: Performance and Analysis

Univ. of Oregon, Eugene, OR
p. 34 1977

The actual performance of a passive solar heated greenhouse is examined with respect to the intentions of its designers, its capacity for the raising of plants and vegetables, and its viability for application in the Pacific northwest. Recommendations are made that would improve greenhouse performance without any increase in operating cost. The greenhouse is below ground on the north side and the north slope of the roof has 12 inches of sod. Recycled and locally available materials are used where possible.

ST79 39007 Proceedings of a Conference on Solar Energy for Heating Greenhouses and Greenhouse-Residential Combinations

Ohio Agricultural Res. and Dev'ment Center, Wooster, OH; ERDA, Washington, D.C.
Conf. Proc. on Solar Energy for Greenhouses and Greenhouse-Residential Combinations
Avail:NTIS, CONF-770367 p. 350 Cleveland, OH March 20, 1977

Seventeen papers are included. A separate abstract was prepared for each for Energy Research Abstracts (ERA); eight are included in Energy Abstracts for Policy Analysis (EAPA).

ST79 39008 Solar Greenhouse Book

Rodale Press, Inc., Emmaus, PA
SBN 0-87857-198-1 p. 339 1978 $10.95

Details are given for constructing freestanding, attached, and pit greenhouses and solar coldframes. Historical and contemporary designs and regional examples are shown. Natural and artificial climate control, using the greenhouse as a solar collector to provide part of a home's heating requirement, heat loss and storage, glazing, and weather effects are discussed in detail from a design standpoint. Emphasis is on low-cost and non-technical application of solar energy. Information on light, energy, atmosphere, ventilation, irrigation, composting, soil nutrition, and insects and diseases are included. Chapters on solar greenhouse gardening tell how to grow various vegetables and other plants successfully. Special charts and appendices help the reader evaluate the cost-effectiveness of a solar greenhouse and locate a structure for maximum efficiency.

ST79 39009 Crop Response in Solar Heated Greenhouses Ventilated With Deep Coal Mine Air

Buxton, J.W.; Walker, J.N.; Collins, L.; Knavel, D.; Hartman, J.
Proc. of Conf. on Solar Energy for Greenhouses and Greenhouse-Residential Combinations
CONF-770367 p. 166-185 March 20, 1977 Cleveland, OH

A mine air ventilated greenhouse was suitable for production of many greenhouse crops from mid-February through November. The temperature ranged from 16 C (60° F) to 30 C (85° F) during the day and remained a constant 12 to 13 C (53° to 55° F) at night. High-quality lettuce, snapdragons, carnations, and bedding plants were grown in the greenhouse during the period. During the winter the relative humidity remained near 100 percent day and night. The constant high humidity caused serious diseases and physiological problems on lettuce, carnations, and snapdragons.

ST79 39010 ...and Here's a Solar Greenhouse You Can Build

Crowley, J.S.
Popular Science V 213 p. 126 Sept. 1978

No abstract available.

ST79 39011 Energy Management and Energy Tools That Can be Used by the Greenhouse Grower

Pretzer, R.
Pretzer Farms, Cleveland, OH
Proc. of Conf. on Solar Energy for Heating Greenhouses and Greenhouse-Residential Combinations Cleveland, OH March 20, 1977
CONF-770367 p. 8-13

Energy storage, total energy, and new approaches to energy usage are discussed in general terms. An air support is pictured and its advantages are mentioned. The need for suppliers to get new products to the growerw is emphasized.

ST79 39012 Solar Greenhouse: Energy Misers Trap Sun's Heat

Stepler, R.
Popular Science V 213 p. 120 Sept. 1978

No abstract available.

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KEYWORD INDEX

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SOLAR-HEATING-AND-COOLING#
SOLAR-HEATING, AGRICULTURE, RU
SOLAR-HEATING, BUILDINGS, CANA
SOLAR-HEATING, COOLING, BUILDI
SOLAR-HEATING, COOLING, DEMONS
SOLAR-HEATING, COOLING, BOOK,
SOLAR-HEATING, GUIDE, DIRECTOR
SOLAR-HEATING, HEAT-REQUIREMEN
SOLAR-HEATING, REPORT, LOAD-MA
SOLAR-HEATING#
SOLAR-HEATING#
SOLAR-HOME, DESIGN, RETROFIT,
SOLAR-HOT-WATER, COMPUTER-PROG
SOLAR-HOUSE, NETHERLANDS, COMP
SOLAR-HOUSE, PERFORMANCE, STOR
SOLAR-IDEAS, HOMES, ENERGY-CON
SOLAR-POOL-HEATING# ENGLAN
SOLAR-POOL-HEATING# /ON, CONTR
SOLAR-POOL-HEATING# /ZING, DES
SOLAR-POWERED, AIR-CONDITIONIN
SOLAR-POWERED, SIMULATION, AIR
SOLAR-RADIATION, AUSTRALIA, TI
SOLAR-RADIATION, MODEL, COMPAR
SOLAR-WATER-HEATING, ECONOMICS
SOLAR-WATER-HEATING, STATISTICS
SOLAR-WATER-HEATING, FLORIDA,
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SPACE-CONDITIONING, ELECTRIC,
SPACE-HEATING, AM.-GAS-ASSOC.,
SPACE-HEATING, LOANS#
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STATISTICS, INSTALLATIONS# /T,
STORAGE# HYBR
STORAGE# PATENT, GERMAN,
STRATIFICATION, WATER-STORAGE,
STRUCTURE, INSULATION, PATENT#
STUDY-GUIDE, FUNDAMENTALS, SOL
STUDY, COOLING, SOLAR-HEATING,
STUDY, HOSPITAL, ENERGY-REQUIRE
SUN, WEATHER, CLIMATE#
SUNSHINE, ENGLAND, PASSIVE, SC
SWIMMING-POOLS, ENGLAND, SOLAR
SWIMMING-POOLS, FLORIDA, SOLAR
SWIMMING-POOLS, SOLAR-POOL-HEA

*SYSTEMS * NOT INDEXED

TABLES, INSOLATION# /-RADIATIO
TABLES# MODELS,
TEMPERATURE-CONTROL# G
TEMPERATURE, WIND, COMPUTER-PR

LIST OF ABBREVIATIONS

ACES: American Chemical Engineering Society

AIA: American Institute of Architecture

AIAA, Inc.: American Institute of Aeronautics and Astronautics

2nd AHPT Conf.: 2nd Annual Heat Pump Technology Conference

AIChE: American Institute of Chemical Engineers

AIEC Workshop: Aluminum Industry Energy Conservation Workshop

ASAE: American Society of Automotive Engineers

ASERC: Arizona Solar Energy Research Commission

ASHRAE: American Society of Heating, Regrigerating, and Air Conditioning Engineers

ATEOPPIMOFP: Assessing the Effects of Power-Plant-Induced Mortality on Fish Populations

BNL: Brookhaven National Laboratory

BPNL: Battelle Pacific Northwest Laboratories

DAA, Inc.: Development Analysis Associates, Inc.

DOC: Department of Commerce

DOE: Department of Energy

EDA: Economic Development Administration

EPA: Environmental Protection Agency

EPRI: Electric Power Research Institute

EPRI WTFCAEUEE: EPRI Workshop on Technologies for Conservation and Efficient Utilization of Electric Energy

ERDA: Energy Research and Development Administration

FEA: Federal Energy Administration

FRG: Federal Republic of Germany

Dept. HUD: Department of Housing and Urban Development

3rd Mtg. on HWTS II: 3rd Meeting on Heating with the Sun II (2)

IEA: International Energy Agency

IEEE, Inc.: Institute of Electrical and Electronic Engineers, Inc.

12th IEEE PSC: 12th Institute of Electrical and Electronic Engineers Photovoltaic Specialists Conference

12th ISECE Conf.: 12th Intersociety Energy Conversion Engineering Conference

JPL: Jet Propulsion Laboratory

LASL: Los Alamos Scientific Laboratory

LLL: Lawrence Livermore Laboratory

NASA: National Aeronautics and Space Administration

NBS: National Bureau of Standards

NESEA: New England Solar Energy Association

NMEI: New Mexico Energy Institute

NMSU: New Mexico State University

NOAA: National Oceanic and Atmospheric Administration

NPAEF Royal Inst. Forum: Nuclear Power and the Energy Future Royal Institute Forum

NRPA: National Recreation and Park Association

NSF: National Science Foundation

NTIS: National Technical Information Service

ORNL: Oak Ridge National Laboratories

SCAH Nat'l Forum: Solar Cooling and Heating National Forum

SEFHGAGRC Conf: Solar Energy for Heating Greenhouses and Greenhouse/Residential Combinations Conference

SGD Conf.: Solar Grain Drying Conference

SOISIAMOLMFBRS (Mtg. of): Meeting of Specialists on In-Service Inspection and Monitoring of LMFBRS

SWOAEES (1976): 1976 Summer Workshop On An Energy Extension Service

WOCFAHE: Workshop On Ceramics for Advanced Heat Engines